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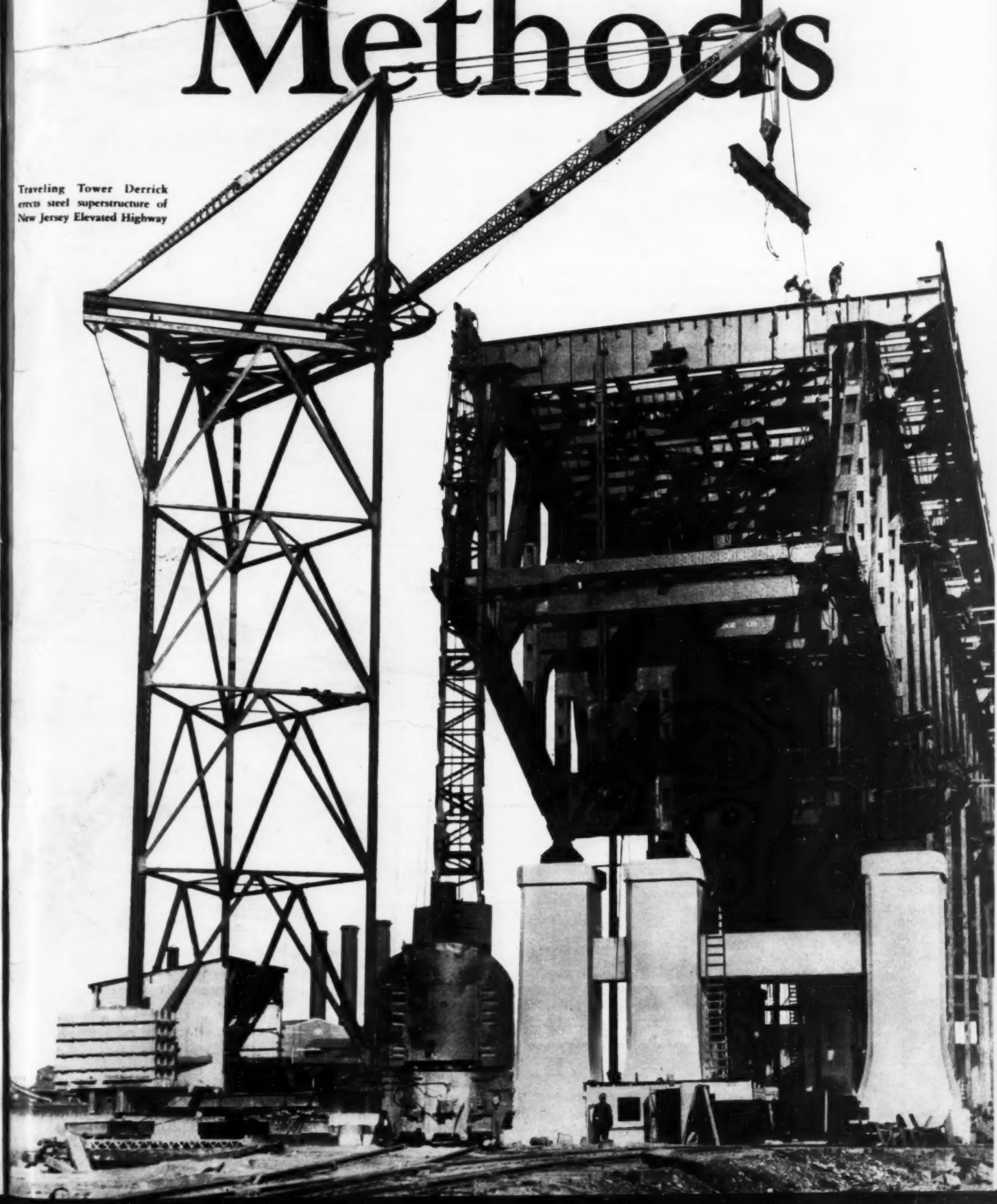
Construction Methods

Traveling Tower Derrick erects steel superstructure of New Jersey Elevated Highway



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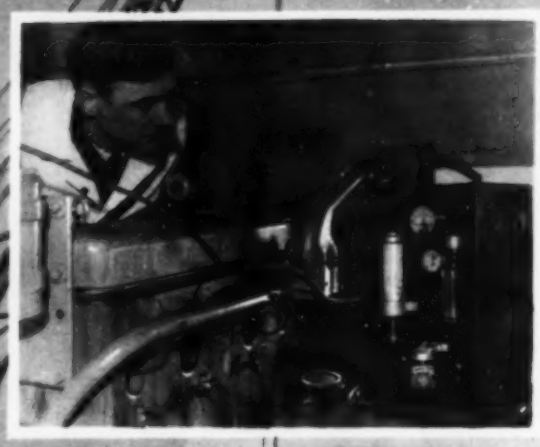

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Construction Methods

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ROBERT K. TOMLIN, Editor
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WILLARD CHEVALIER, Publishing Director

Bold Methods for Bridge Piers

• For boldness and originality the method of building subaqueous piers for the Danish State Railways bridge across the Little Belt, a channel between the Baltic and the North Sea, appeals to the imagination of construction-minded men. As described elsewhere in this issue, the problem was to build four piers at depths of 100 ft. or so below the surface of the channel that separates the mainland of Denmark from the island of Funen, on its east coast. Instead of resorting to the pneumatic caisson methods commonly employed under such circumstances, the contractors developed a plan doing away with the use of compressed air and substituting for it a scheme of building concrete caissons on shore, launching them like ships, sinking them to place and raising their tubular sidewalls by steel pipe extensions to form a cofferdam within which work could be carried on in open air.

The novel part of the operation consisted in capsizing the caissons, after they had been launched, and rotating them, while floating, through an arc of 180 deg. to bring them into upright position for subsequent sinking. This step was necessitated by the fact that the caissons, with their lower or cutting edges irregularly shaped to fit the contour of the channel bed at each bridge pier site, had to be built upside down on the launching ways in order to facilitate their entry into the water. During construction, therefore, the flat top of the roof of the working chamber served as the launching base of each caisson, while its tubular walls of uneven height extended upward.

Once floating in the water, however, each caisson was eccentrically loaded with water and gravel ballast, causing it to list, "turn turtle", and emerge right side up. A ticklish job, this, but one which was successfully handled.

Copyright, 1933, New York Tribune, Inc. *Courtesy New York Herald Tribune.*

Diverse Steel Erection Methods

• A varied approach to the problems of assembling and supporting during erection multiple steel-truss spans of a high-level structure distinguished the field fabrication, across the meadows approaching the Holland tunnel, of New Jersey's elevated highway, described in this issue. Highly individual methods of attack were carried into effect by the four principal erecting firms, each of which directed its erection scheme to gain certain advantages while sacrificing others which seemed in each case to offer smaller measures of economy. The variable character and general low bearing value of the soil were dominant considerations leading to different methods of erection.

One firm reduced the amount of falsework and number of supporting piles by adding erection members to the structural design to permit cantilever construction. Another erector, on more stable soil, favored straightforward assemblage by deck traveler, with as many steel falsework bents on grillage pads as were required for each span. A third contractor, on soft ground, eliminated erection equipment on the deck and gained operating flexibility by placing derricks on traveling towers. On a fourth section, where the grade of the deck was not high above ground, still another concern carried on erection with locomotive cranes.

In each case, the contracting firm designed its erecting equipment and falsework system to fit natural conditions and produce a completed structure at least cost. The experience and resources of the builders are sufficient assurance that they gave mature consideration to many erection schemes before undertaking these contracts. Their diverse methods merit study and comparison by erectors of steel-truss bridges and by all constructors who can draw inspiration and instruction from work that is well planned and correctly planted.

The Future is to the Planners

• To the American Institute of Architects, Robert D. Kohn, past-president, and chairman of the Construction League of the United States, has addressed a message that the construction industry should heed. He said, in part: "The future is to the planners. Hundreds of volumes have been written on the need for economic planning, but so far I have seen no practical plan for putting it into effect. In my opinion, the field of public works offers a great opportunity, right now, for the beginning of an experiment in such nation-wide planning. By 'public works' I mean that large and comprehensive service which is intended to provide to the greatest possible extent the amenities of living to the people. It is to that end that we must apply ourselves to use the thought and the labor of men.

"Visionary and impractical, somebody called me. Well, many of the hard-boiled 'practical' men are now as poor in dollars. Ideals and ideas are the only assets left any of us. I venture then, this prophecy: We shall have, of necessity, a decade of public works construction and rebuilding of our cities and the building up of new and smaller industrial centers, all on a scale never before realized. I hope it will be organized on the basis of long-term, nation-wide planning so that it may give self-respecting work to the unemployed and use that work for the good of all in those places which offer the greatest promise of a decent working life for the maximum number of people. I hope it will be developed so as to teach us how to attack the other economic problems of production and distribution with which we are faced. Above all, I hope the architects of the country will forget the old 'big business' leaders, seize their opportunity before it is too late, take the initiative and join with other essential techniques to bring order out of chaos.

"I am convinced that we are in an era of change for the better. Whatever may be the measure of that change, the function of the planner will be more in demand than ever."

Starting the Works

UNLESS all present indications fail, an end to the construction holiday is in sight. An industry racked to the point of collapse by two long years of privation and suffering looks with renewed hope to a public works program of nation-wide extent. And in doing so its thoughts are not completely selfish. True it is that a public works program offers to construction an opportunity of putting back to work thousands of jobless men within its own ranks. It is true, also, that renewed construction activity will provide other thousands with jobs in the industrial plants throughout the country that supply the equipment and the materials that modern construction demands. Throughout American industry, therefore, a large-scale program of public works construction can sound the whistle that will "start the works."

Why Public Works?

AS THIS IS WRITTEN it appears certain that we shall have a federal public works program. It is about time. For too long we have been dallying with half-way measures while from under us has been slipping the one remaining foundation for a revival of employment and trade.

Before this is in print more details of the program may be available, but from what is known we may infer that success is going to depend largely on a widespread understanding of what a public-works program can accomplish. In the mind of the average citizen certain questions about public works are likely to arise. Answers to a few of them are offered in the hope that our readers may find them helpful:

FIRST: *How can we use any substantial part of the unemployed on public works?* We can't. But it is a common mistake to assume that construction involves only the men we see on the job. Back of them, unseen, are many more who produce the materials and equipment used on the work. The construction industry includes thousands of mills, factories, quarries, gravel-pits, with hundreds of thousands of workers. When construction ceases they are idle; in some cases entire villages, supported solely by the activity of a local industrial plant, are wiped out. When construction is resumed they go back to work. It is this far-reaching employment that makes construction so vital a factor in recovery.

SECOND: *How can the government undertake to spend billions without unbalancing that budget we have fussed about so much?* Because now that the *current operating budget* has been balanced we have reestablished the national credit and can borrow the necessary funds.

THIRD: *If, as we are told, so much of our present trouble results from debt, how can we help by going into more debt?* We can't, unless we are careful about what we do with the money we borrow. Certainly, if we continue to borrow for current needs, to refund old debts, to pay veterans' bounties, direct relief and other running expenses, we should simply go deeper into the hole, destroy our credit and get nowhere. But if we borrow for *productive* purposes, revive normal employment and stimulate reproductive enterprise and trade, we are setting in motion forces that will create the incomes required to service the debt and in time to pay it off.

FOURTH: *Why should the government have to stimulate trade?* Because, to come out of a depression, it is necessary for some one to *resume capital investment*. Industry produces two kinds of goods: (1) consumable goods, like food, clothing and amusements, which are used up as fast as they are made and should be paid for out of current income; (2) capital or durable goods, like steel, cement, and machinery, which go into permanent works or equipment such as buildings, locomotives, highways. These may properly be bought on credit. From 35 to 40 percent of our workers are employed in making and handling goods of the latter type. And when that kind of work is stopped so many are thrown out of work that we cannot hope to maintain general trade and employment. So things go from bad to worse.

FIFTH: *If it is necessary to make this start in capital investment, why cannot private industry do it?* Because, with an excess of capacity on its hands, private industry cannot take the risk of borrowing to build more until it sees some evidence of improvement. On the other hand, unless the country is going altogether to smash, our communities always will have use for new public facilities sooner or later. And right now, due to the suspension of projects during the last couple of years, we are nearly three billions of dollars behind our normal investment in public works. So the government, with the credit of the nation behind it, is about the only agency that is in position to take the initiative in this essential move to revive capital investment.

SIXTH: *Why is public construction especially helpful in stimulating trade?* Because public works employment does not produce competition with private business. The people that find employment in the many branches of the construction industry will have money to spend for the products of private business while their employment will not increase the supply of consumer goods or the facilities for producing them. There is a net gain in the demand for the products of private business.

THESE ARE BUT A FEW of the questions that will arise. When the public works program is announced there may be others. In any event, these queries are basic and every man in the construction industry should be prepared to answer them.

Willard Chevalier

Publishing Director

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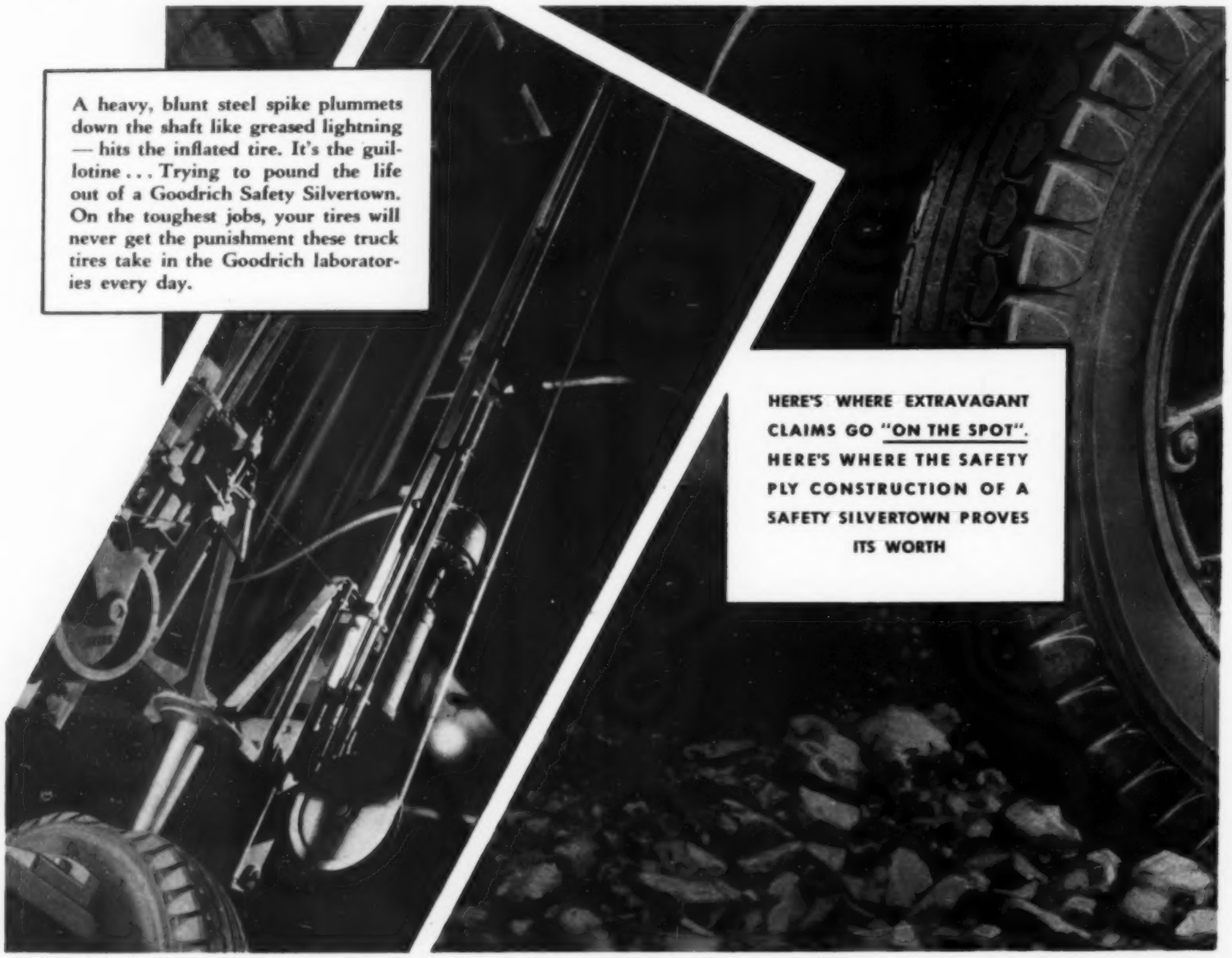

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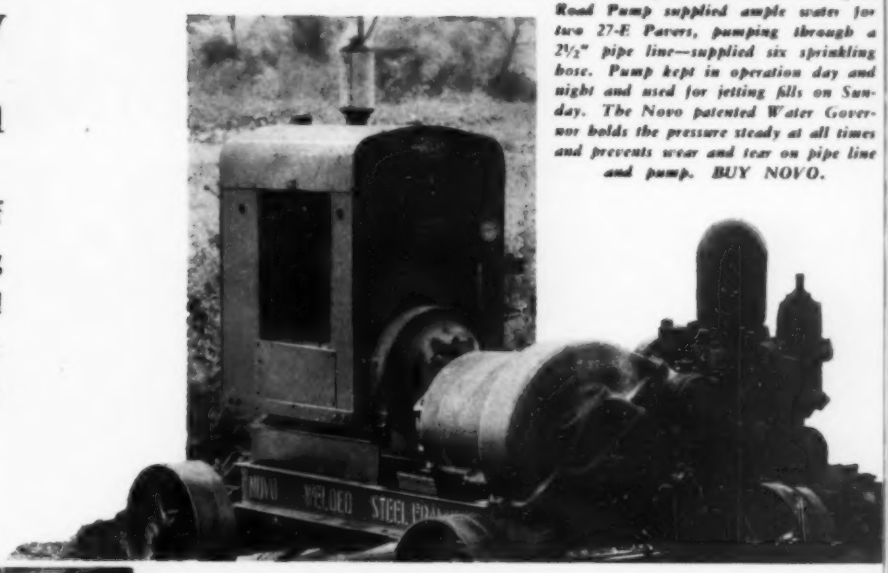
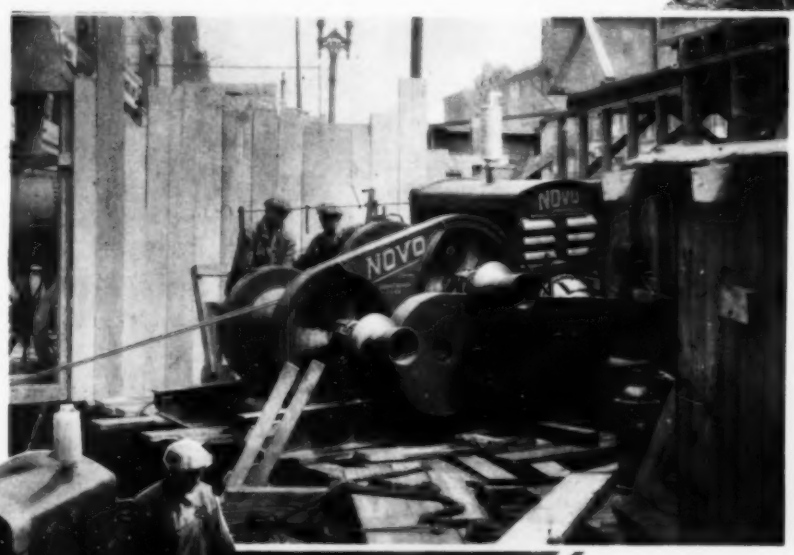


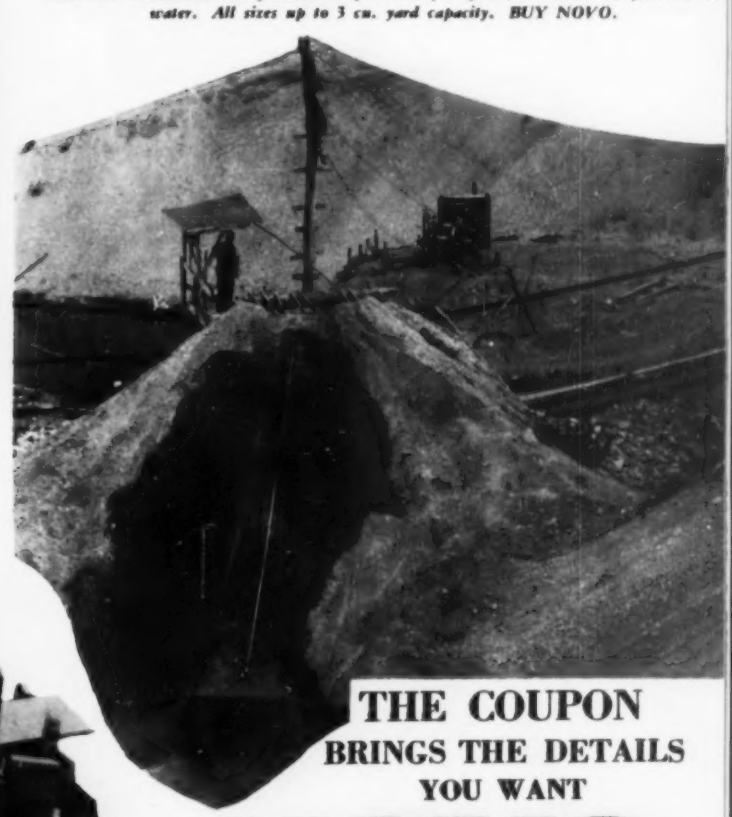
This user reports that his Novo Triplex Road Pump supplied ample water for two 27-E Pavers, pumping through a 2½" pipe line—supplied six sprinkling hose. Pump kept in operation day and night and used for jetting fills on Sunday. The Novo patented Water Governor holds the pressure steady at all times and prevents wear and tear on pipe line and pump. BUY NOVO.

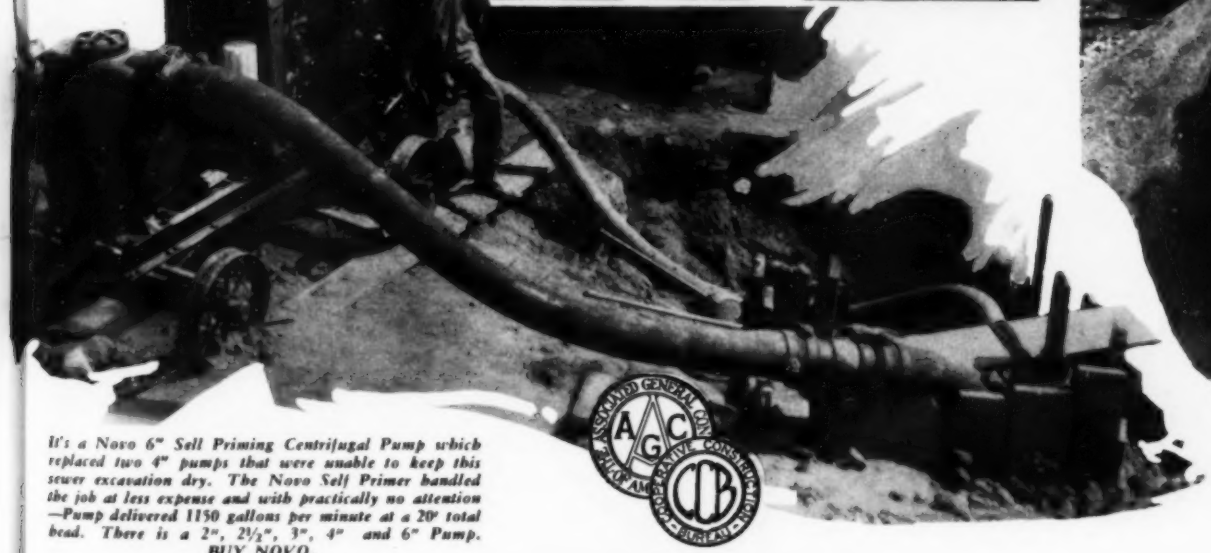


Novo two-drum heavy duty hoist used on this job for placing steel. The girder being placed weighs 60,240 lbs. and is 50 feet long. All drum shafts and thrust bearings are of the roller bearing type. The frame is of welded structural steel.

There is a complete line of Novo Hoists from 2 to 150 Horse Power. Put one to work. BUY NOVO.

Below: This is the cheapest way to take out sand and gravel: The Novo Dragline way. One man is operating this hoist and 1 yard bucket, (lines are run from hoist levers to operator's platform) which is taking out 600 cu. yds. of aggregate a day. A set-up that is easy to build and simple to operate—The investment is low. One man can excavate over any distance up to 400 ft. up hill or down—or from under water. All sizes up to 3 cu. yard capacity. BUY NOVO.





It's a Novo 6" Self Priming Centrifugal Pump which replaced two 4" pumps that were unable to keep this sewer excavation dry. The Novo Self Primer handled the job at less expense and with practically no attention —Pump delivered 1150 gallons per minute at a 20' total head. There is a 2", 2½", 3", 4" and 6" Pump. BUY NOVO.

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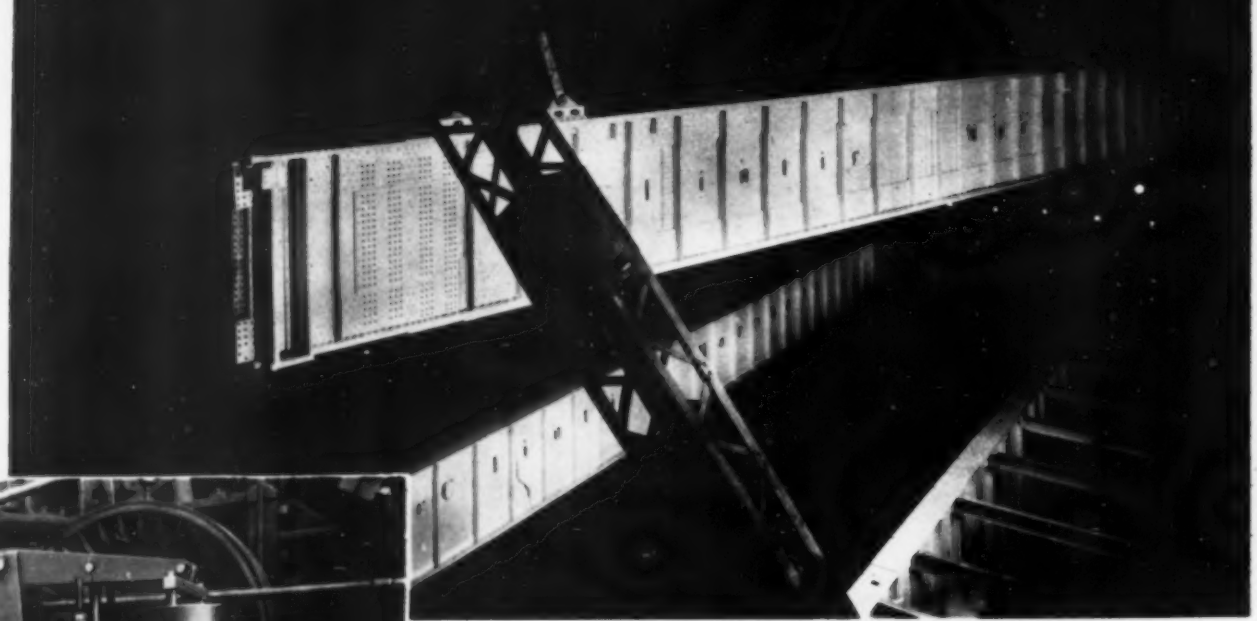

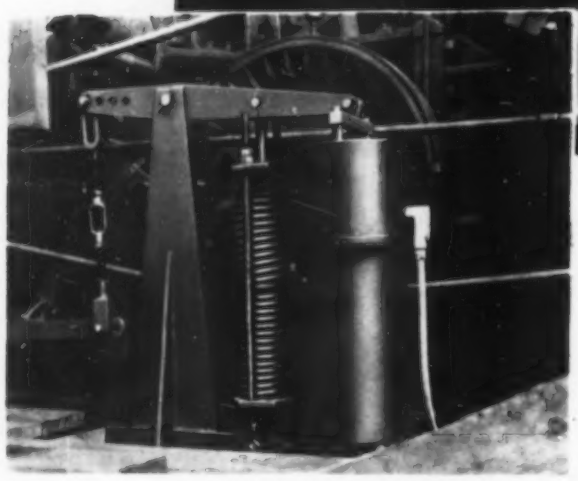

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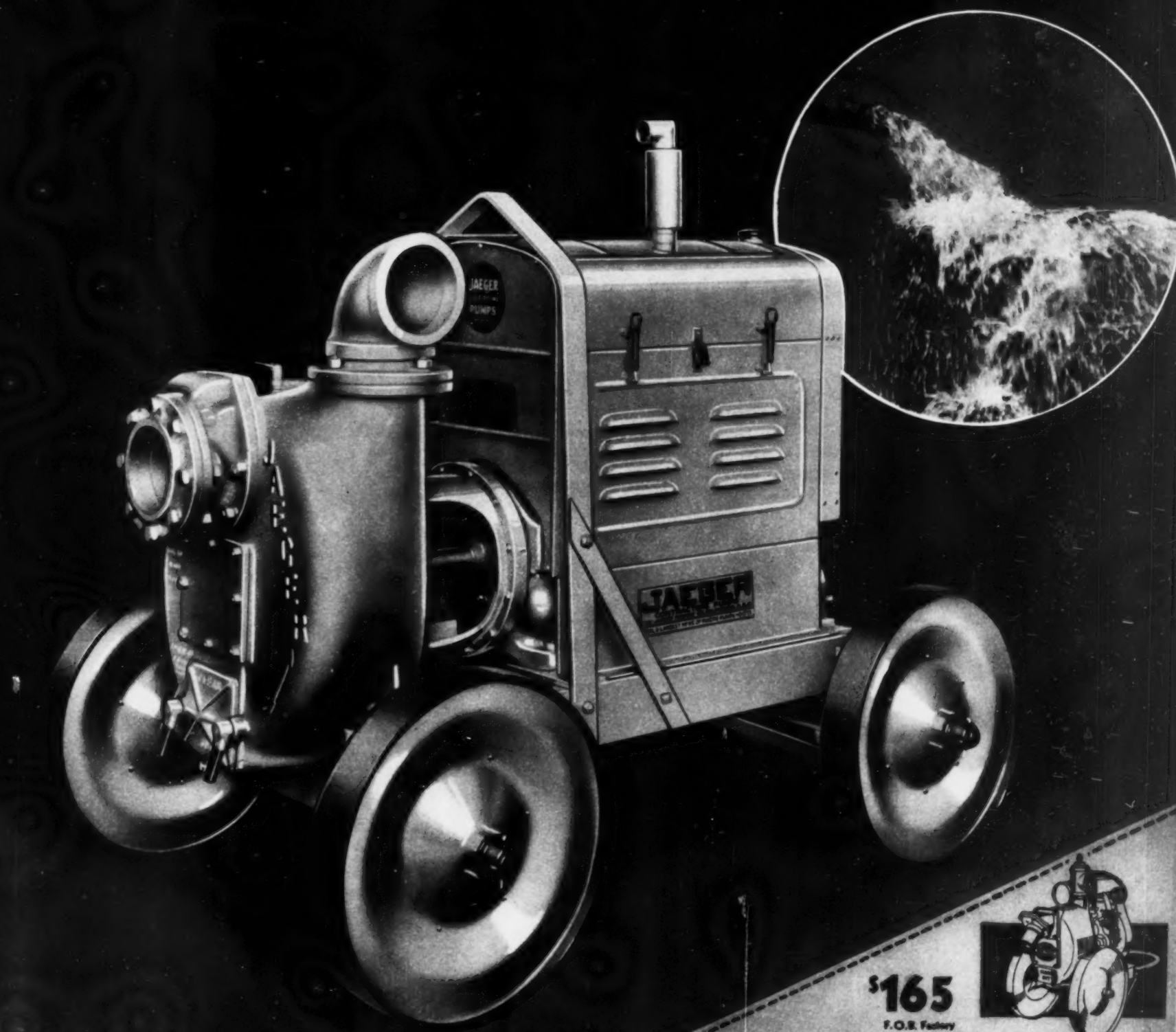

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Construction Methods

ROBERT K. TOMLIN, Editor

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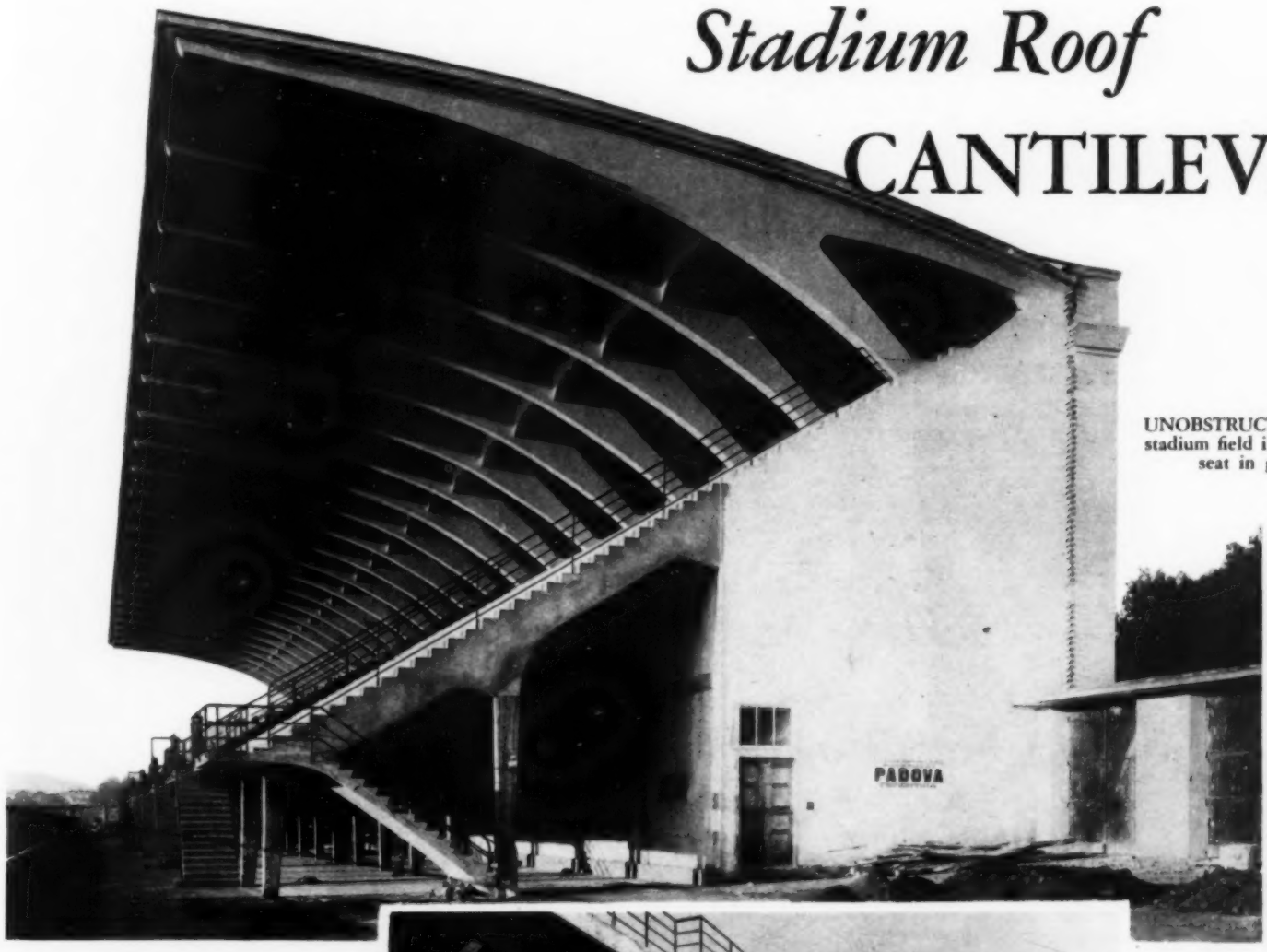
Stadium Roof CANTILEVERED



UNOBSTRUCTED VIEW of stadium field is afforded by any seat in grandstand.

Photos, La Technique des Travaux

HELICOIDAL STAIRWAY *(below)* of novel concrete design serves uncovered stands.

CANTILEVERED roof construction, affording spectators an unobstructed view of track and field events without the annoyance of intervening columns or posts, is a feature of the reinforced concrete grandstand at the new Giovanni Bertha municipal stadium in Florence, Italy. Covering an area of nearly 10 acres, the stadium project, designed by Pier Luigi Nervi, engineer, of Rome, includes a football field and running track entirely surrounded by concrete stands with a capacity of seating 32,000 people. As described by *La Technique des Travaux,* Paris, the stands comprise uncovered tiers of seats of the "bleacher" type and a main, covered grandstand, about 361 ft. in length, seating 5,000 spectators and facing the center of the field. The accompanying illustrations show the general design features of the cantilevered grandstand roof and a novel helicoidal concrete stairway serving the uncovered stands.

The grandstand roof is supported by a series of reinforced concrete trusses with an overhang of about 72 ft. Calculated for a load of 24½ lb. per square foot, the roof design provides for minimizing the weight of the cantilever covering by using hollow tile blocks 5½ in. thick between concrete stringers. The top surface is covered by a thin layer of asphalt to make it watertight. At every third bay of the roof structure an expansion joint is provided by dividing the supporting truss into halves and interposing layers of tarred roofing paper above and below the hollow tile blocks at their point of support to allow for free movement at their ends.

The covered grandstand with its cantilevered roof was built by Nervi & Nebbiosi.

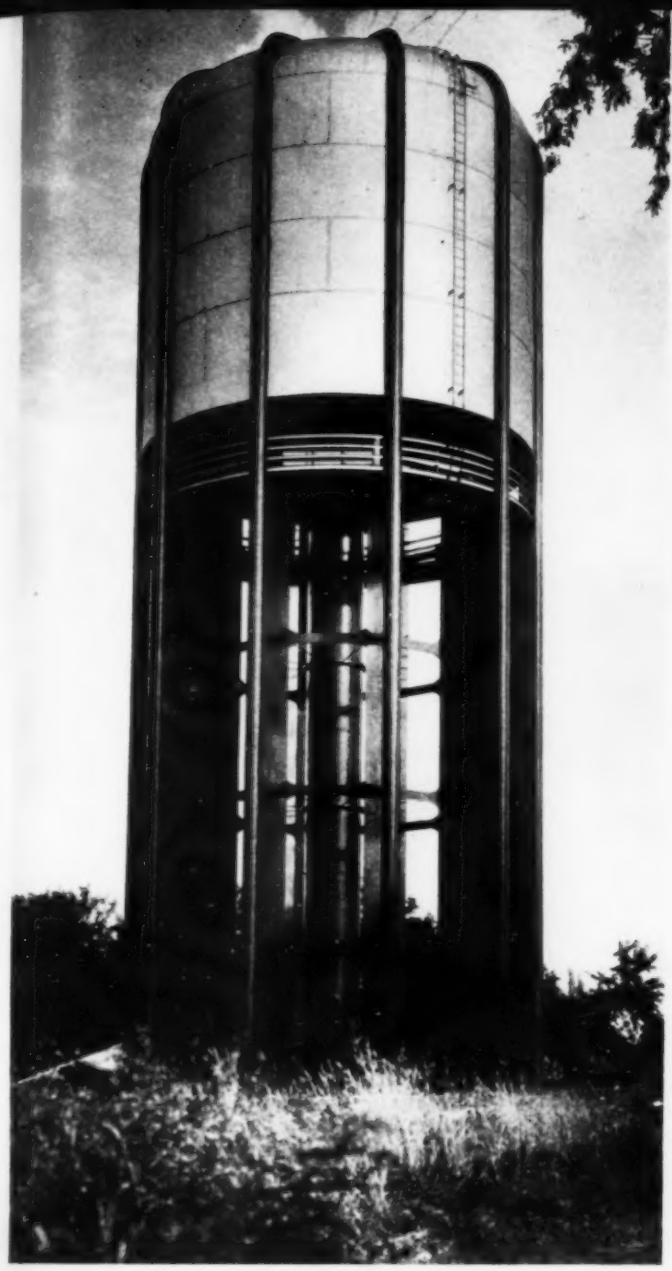
625-FT. STEEL TOWER *(left)* erected to support cables carrying rocket cars for sky ride thrill at Chicago's Century of Progress Exposition.

MASS CONCRETING under way at Pine Canyon dam, 240-ft. high structure across San Gabriel River being built by joint contracting organization of Bent Bros., Inc., Winston Bros. Co., and William C. Crowell for Water Department of Pasadena, Calif. Vibrators are used in placing 440,000 cu. yd. of "no-slump" mix concrete delivered by 4-yd. bottom-dump buckets.

This Month's

"NEWS REEL"

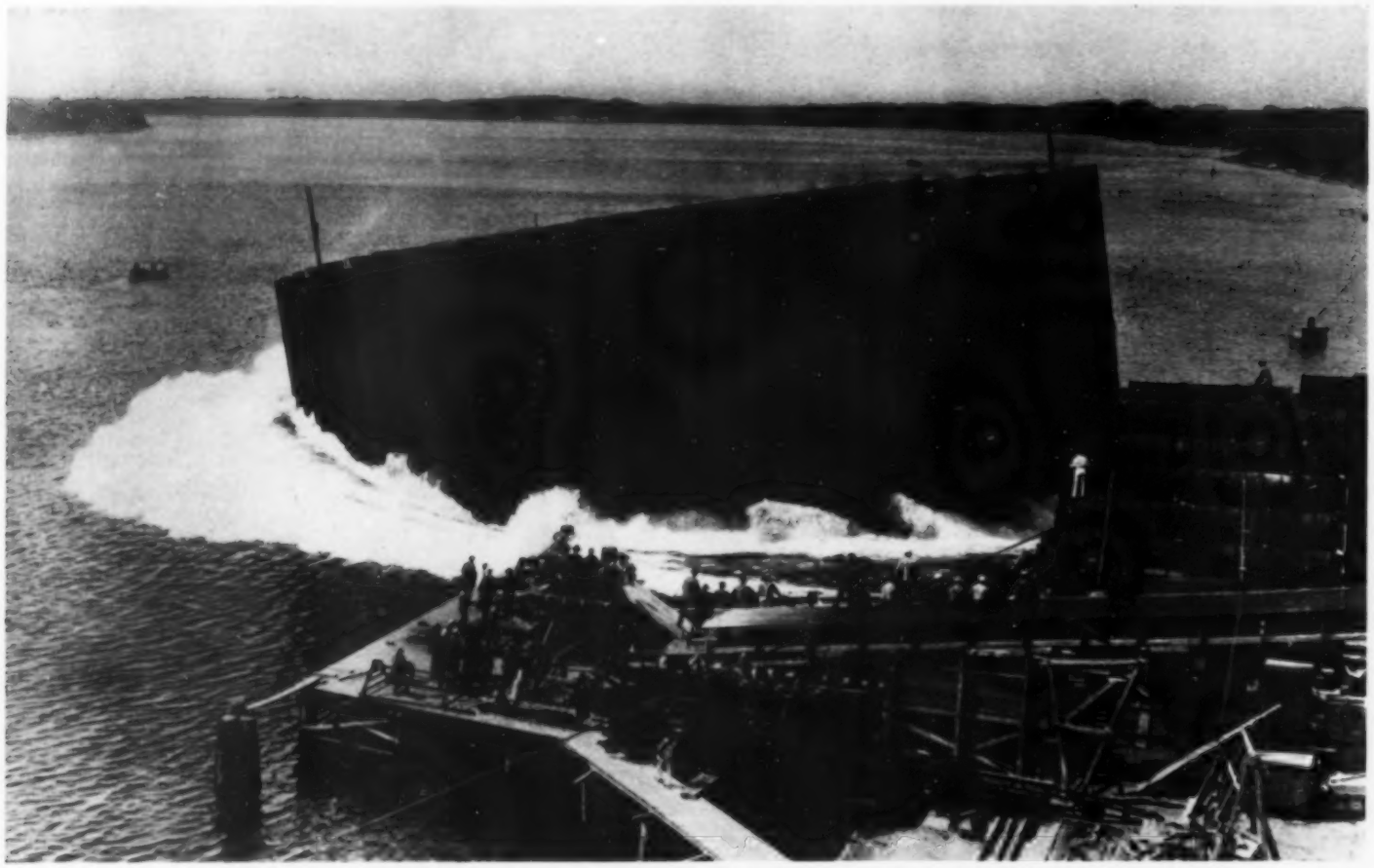
ENGINEER MAYOR *(right)* for Chicago. Edward J. Kelly, former chief engineer of city's Sanitary District, succeeds to post made vacant when assassin's bullet killed former Mayor Anton J. Cermak.



DECORATIVE STEEL WATER TOWER, supporting 300,000-gal. tank, is completed at Towson, Md., for Baltimore County Metropolitan District. Structure 102 ft. high follows design that won first prize in competition sponsored by Chicago Bridge & Iron Works.

EXCAVATION FOR HOOVER DAM FOUNDATIONS begins as completed cofferdams divert flow of Colorado River around site through 50-ft. concrete-lined tunnels in canyon walls. View looking upstream shows five 3½-yd. Marion electric shovels loading rock wall strippings and streambed gravel into motor trucks.

HUME RESERVOIR PROJECT *(below and on facing page)* on Murray River, Australia, provides for increasing storage capacity for irrigation to 255,000 acre-ft. by filling gap in spillway opening with concrete delivered by belt conveyors. Work is jointly financed by Commonwealth government and governments of Victoria, New South Wales and South Australia.

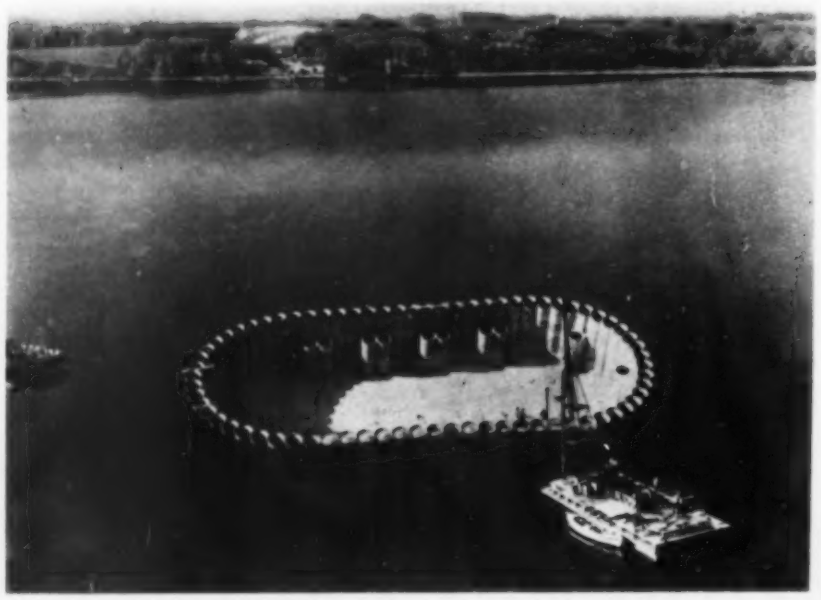


IN UPSIDE DOWN POSITION concrete caisson is launched from ways like a ship and later righted by "turning turtle" while floating in water.

Concrete Caissons for Danish Bridge Piers

LAUNCHED, CAPSIZED AND SUNK

BUILT upside down on shore, launched like a ship, capsized, rotated through 180 deg. into an upright position, and finally sunk to depths of more than 100 ft. below sea level without the use of compressed air—these are the steps taken in building and placing open concrete caissons for the pier foundations of a steel railway and highway bridge connecting the mainland peninsula of Denmark with the island of Funen on its eastern coast. The structure, crossing the strait called the Little Belt, joining the Baltic Sea and an arm of the North Sea, has a total length of 3,863 ft. It consists of 1,157 ft. of concrete arch approaches and a five-span steel cantilever bridge 2,706 ft. long carried across the channel on four subaqueous pier foundations constructed by novel, daring methods described by *La Technique des Travaux*, Paris, the source of the following notes:



GRAVEL BALLAST is placed in tubular walls on one side only of floating caisson to create eccentric load which, with additional water ballast, causes caisson to capsize and rotate 180 deg. to upright position.

The bridge, a project of the Danish State Railways, provides a clearance of 102 ft. above water level. The main channel span has a length of 721 ft., the two intermediate spans, 541 ft. each, and the end spans, 451 ft. each. The depths below water of the pier foundations range from 79 to 121 ft., so that the tallest pier has a total height of 223 ft. from its top to the bottom edge of its supporting concrete caisson base. The pier foundations were built by two contractors: Grun & Bilfinger A.-G., of Mannheim, Germany, which developed and patented the special open-caisson methods of construction, and Monberg & Thorsen, of Copenhagen.

The material forming the channel bottom at the bridge site is a compact, impervious clay into which the caisson piers penetrate from 20 to 23 ft. The scheme of construction employed is notable in that it eliminates the com-

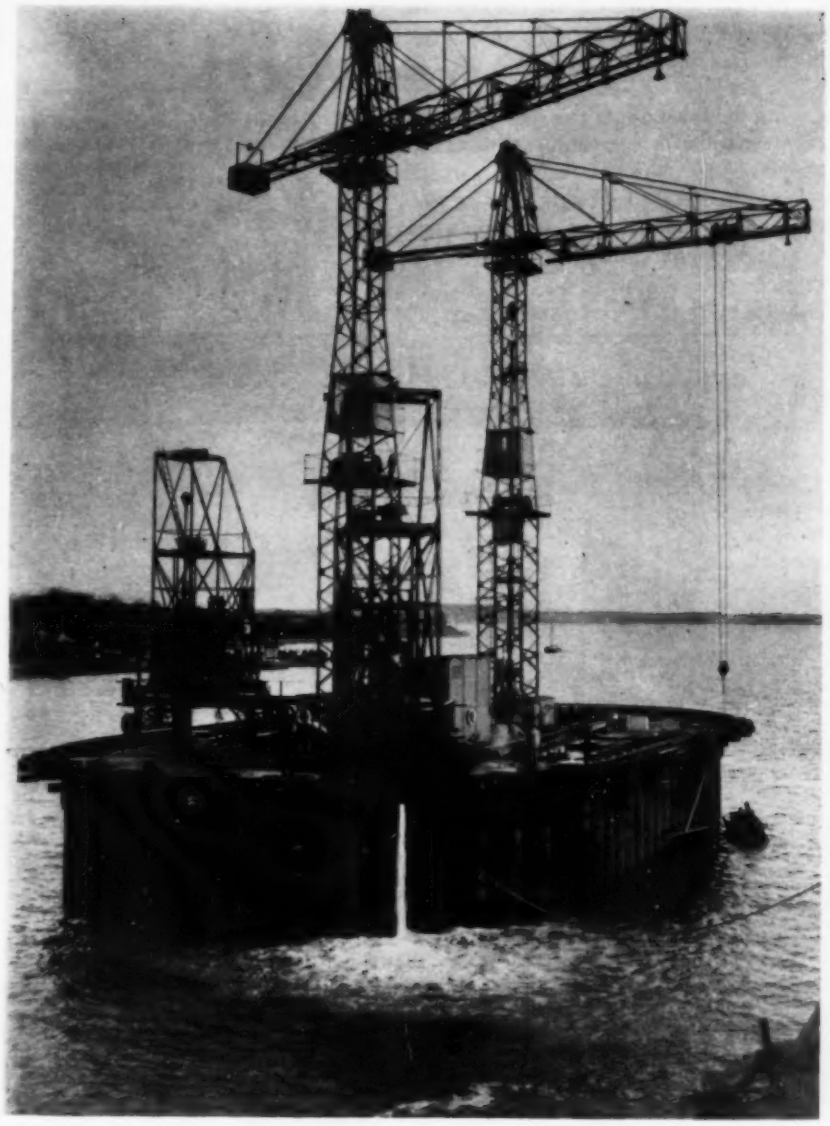
pressed-air methods and equipment ordinarily employed on this type of deep underwater foundation.

Briefly, the scheme for the bridge pier foundations consists of building on launching ways along the shore line open concrete caissons 142 ft. long and 74 ft. wide; in plan, these caissons are rectangular with rounded ends (see sketch). The bearing area of each caisson is 1,124 sq. yd. The sides of each caisson are formed by a ring of 98 vertical steel pipes encased in concrete with inside diameters of about 4 ft. and wall thicknesses of 6 in. A thick concrete slab forms the roof of a working chamber in the bottom of the caisson.

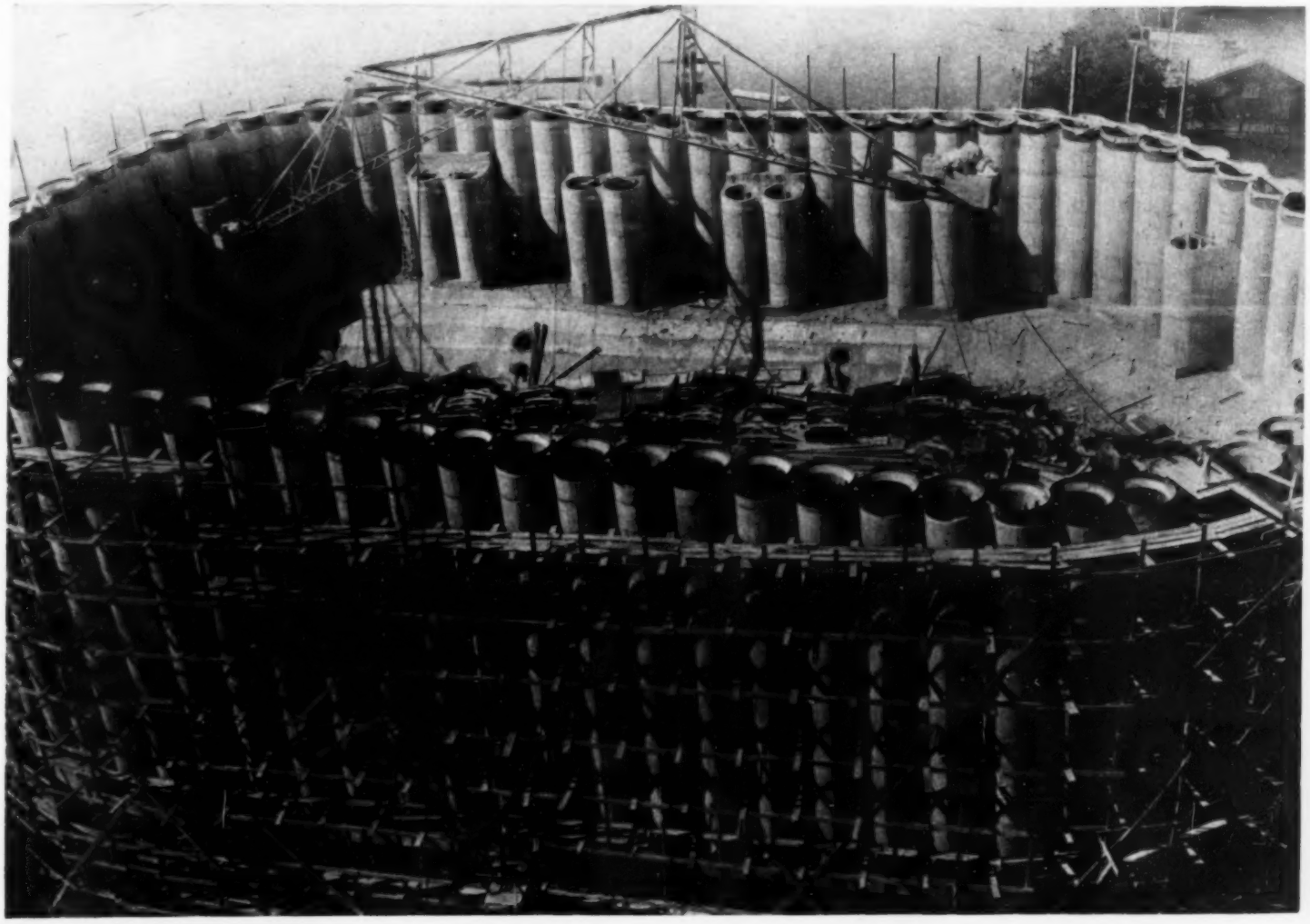
Built Upside Down—As constructed on shore the caisson is upside down. The reason for thus inverting the structure during the process of building is to facilitate its launching. The channel bottom at each bridge pier site is irregular and the caisson, therefore, must be shaped to make its base fit accurately the contour of the subaqueous clay bed, as determined by soundings. The tubular units forming the sidewalls, consequently, are of different lengths to produce the desired profile. A heavy caisson with an irregular supporting base of this sort would have been difficult to launch safely. The problem was solved, therefore, by inverting the caisson on the launching ways during its construction on shore and righting it after it had been floated out into the channel, as described later. In other words, during construction on the launching ways, the roof of the working chamber of the caisson actually serves as its base, from which the irregular ends of the tubular sidewalls extend upward, as illustrated in one of the photographs.

Launched Like Ship—The most spectacular feature of the methods employed is the launching and capsizing of the caissons. When completed, each caisson is lowered on to greased ways by sand jacks and allowed to slide into the water like a ship. Hydraulic jacks are provided to start the mass of reinforced concrete down its inclined path into the sea.

When afloat, the caisson is towed to water deep enough to make possible the next operation, which consists in capsizing the floating mass—up to this point still in inverted position—and turning it right side up. Water ballast is introduced into compartments on one side only, and this weight is supple-



CANTILEVER CRANES ***(left)*** **set steel pipe extension of tubular sidewalls, forming cofferdam within which work on foundation of pier proceeds without compressed air.**



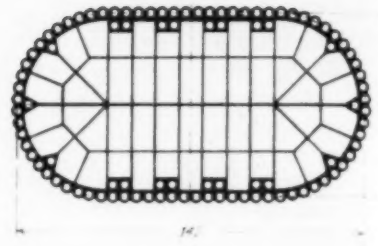
RING OF TUBULAR UNITS ***(below)*** **forms sidewalls of concrete caisson built upside down on ways to facilitate launching. Tops of pipe, as shown, will form cutting edge when caisson is inverted and sunk. Irregular cutting edge profile is built to fit contour of channel bottom at pier site.**

mented by filling with gravel the hollow tubes forming the walls on the same side of the caisson as the water ballast. This eccentric loading tips the caisson over sideways, causing it to roll and "turn turtle," bringing the top of the working chamber uppermost, in proper position for subsequent sinking. After the caisson passes the half-way mark in its 180-deg. arc of rotation, the gravel ballast in the tubular side walls, now tilted with their open ends downward, discharges by gravity, lightening the floating mass and allowing it to right itself after the water ballast is emptied out.

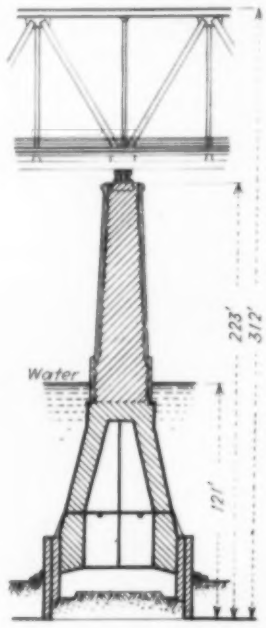
Steel Pipes Extended—With the floating caisson now right side up, it is towed to shallow water and grounded by loading with water ballast. In this position, work begins in extending the heights of the tubular side walls by means of lengths of steel pipe so as to form a tight cofferdam for subsequent operations. The caisson is then refloated, towed into deeper water and the process of wall height extension repeated until the structure is completed. It is then floated out over the bridge pier site and lowered to place on the channel bottom.

The final operation consists in sinking the caisson into the clay bottom of the channel by excavating below its cutting edge through the 4-ft. circular openings provided by the tubular sidewalls of the cofferdam and their vertical steel pipe extensions. This excavation is done by jetting or dredging without resort to the usual pneumatic caisson methods. When the caisson has been sunk to the required depth the tubular wells of the sidewalls of the caisson are filled with concrete, and the concrete body of the pier is extended up to the proper elevation for supporting the steel bridge structure, after which the vertical steel pipe extensions of the sidewalls, forming a temporary cofferdam, are removed.

For extending the height of each pier after its caisson has been launched, concreting is done from a floating plant equipped with inclined chutes and a tower 177 ft. high. The placing and removal of the temporary steel pipe extensions of the tubular side walls, forming a cofferdam, are handled by a pair of tall cantilever cranes, as illustrated in one of the photographs.



PLAN *(right)* **of caisson shows ring of 98 concrete-incased pipes forming sidewalls. Through these pipe wells material under cutting edge is excavated by jetting or dredging.**

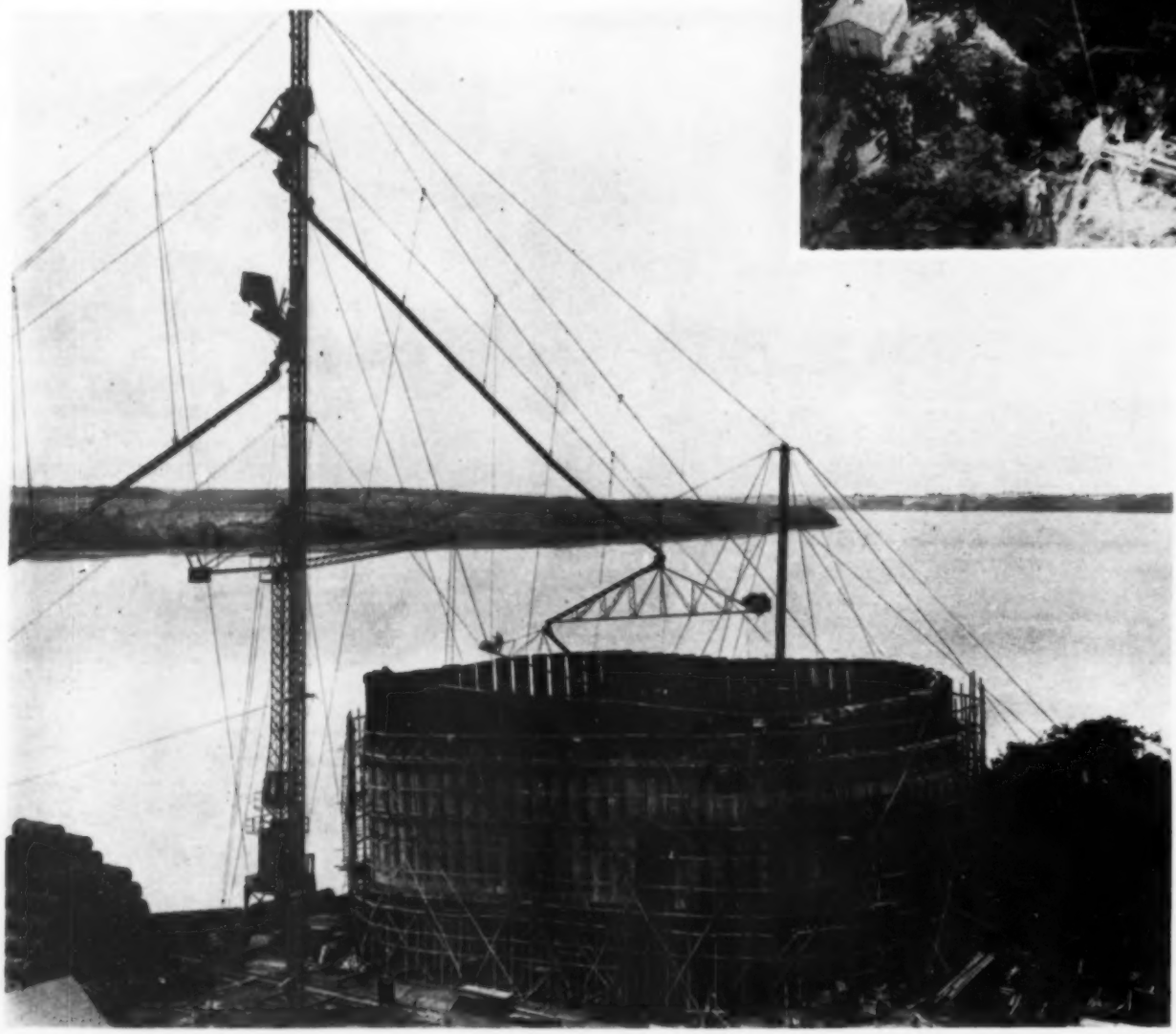


BRIDGE PIER built up on top of concrete caisson floated to place and sunk.

Wide World Photo

READY FOR LAUNCHING. ***(Above)*** **Completed concrete caisson with tubular sidewalls starts sliding down inclined ways into sea, at right.**

CONCRETING ***(below)*** **the caisson on the launching ways is done with tower and chuting equipment. Steel pipe units forming sidewall ring have diameter of 4 ft. and are encased in concrete. At this stage, caisson is in inverted position. Note irregular profile of pipe tops to fit profile of pier site when caisson is "turned turtle" and sunk.**



90-FT. FLAGPOLE ARC-WELDED

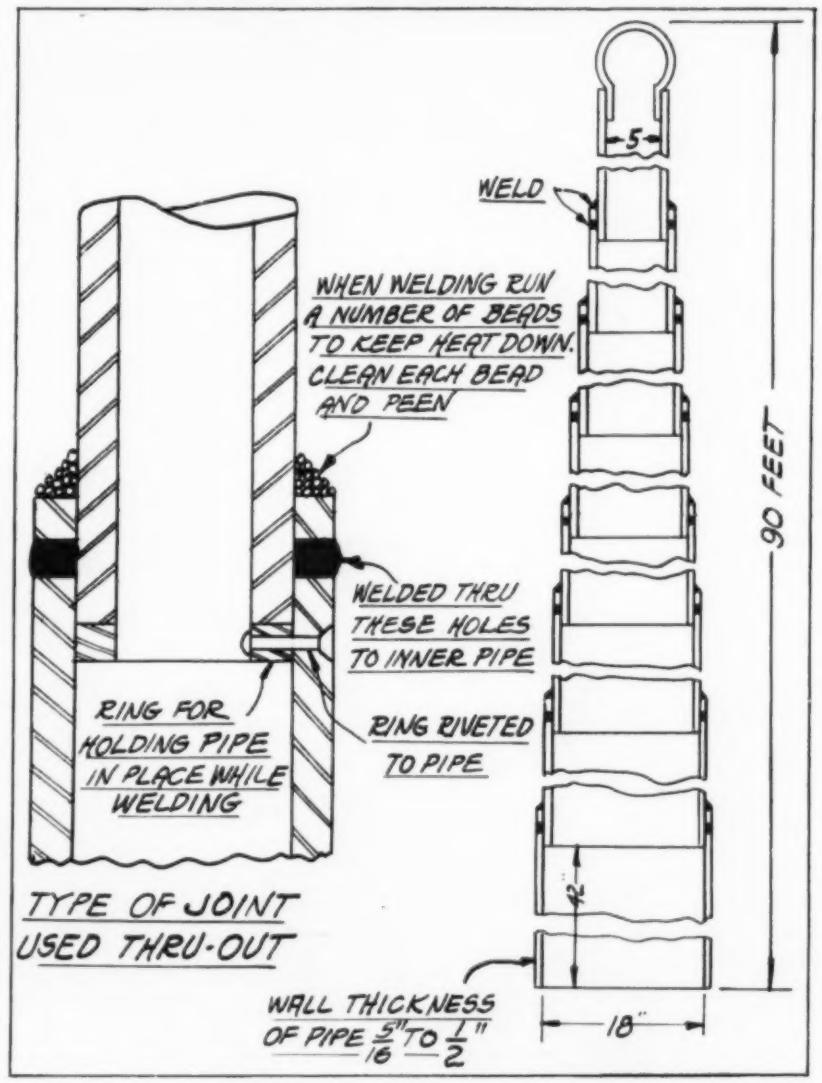
Telescoped Pipe Sections Fabricated Atop Chicago Tribune Tower

DEDICATION ceremonies at the top of the Tribune Tower, Chicago, marked the completion of a new 90-ft. arc-welded steel flagpole which now tops this building. The flagpole consists of telescoped pipe sections fabricated in position on top of the tower at a height ranging from 456 ft. at the base of the pole to 546 ft. at the top. Fabrication of the pole is believed to have set a new altitude record for arc-welding operations. A tubular scaffold tower was used in erecting and welding the pipe sections.

Eight sizes of pipe were used in the construction of the flagpole, the base section having an inside diameter of 18 in., with a wall thickness of ½ in., and the top section having an inside diameter of 5 in., with a wall thickness of 5/16 in., as indicated in the accompanying sketch.

Telescopic construction of the pipe sections required seven sleeve joints. The sketch shows a detail of a typical joint. To hold the next section above in place prior to welding, each section had an inside ring riveted to its wall at a distance below the upper end which varied from 42 in. for the base section to 19 in. for the section next to the top. Each section of pipe, as placed in position, rested upon this ring in the lower section of pipe. Sections were welded in place as erection progressed.

At each joint, adjacent sections were fillet-welded to each other by welding the open edge of the lower section to the outer wall of the upper section around the entire circumference of the pipe. In addition, eight plug welds 1 in. in diameter were made at equally spaced points around the circumference of the pipe near the lower end of the upper section. Thus at each joint the sections of pipe were fused into each other at two separate circumferential bands.


5
WELD
WHEN WELDING RUN A NUMBER OF BEADS TO KEEP HEAT DOWN. CLEAN EACH BEAD AND PEEN
WELDED THRU THESE HOLES TO INNER PIPE
RING FOR HOLDING PIPE IN PLACE WHILE WELDING
RING RIVETED TO PIPE
TYPE OF JOINT USED THRU-OUT
WALL THICKNESS OF PIPE 5/16" TO 1/2"
42
18"
90 FEET

STEEL-PIPE FLAGPOLE *(above)*, 90 ft. high, made up of eight telescoped sections with arc-welded joints is fabricated in place on top of 450-ft. building.

Wind pressure subjects the flagpole to high stresses. It therefore was essential that the metal of the welds have physical characteristics at least equal to those of the pipe metal. As an aid to producing high-strength welds, the Western Welding & Boiler Repair Co., of Chicago, welding contractor, utilized the shielded-arc process, employing Lincoln equipment for this work. The welded construction of the flagpole was carefully inspected during the actual process of welding by the municipal building authorities of the City of Chicago and was approved by them upon completion.

A falsework tower of tubular steel was erected on top of the building to the full height of 90 ft. to facilitate hoisting, placing and welding of the steel pipe sections. Welding operators and inspectors worked on wood plank platforms laid on the landings of the tubular tower. The interior pipe rings supporting the next sections above during the welding operations were riveted on to the pipe in the shop.

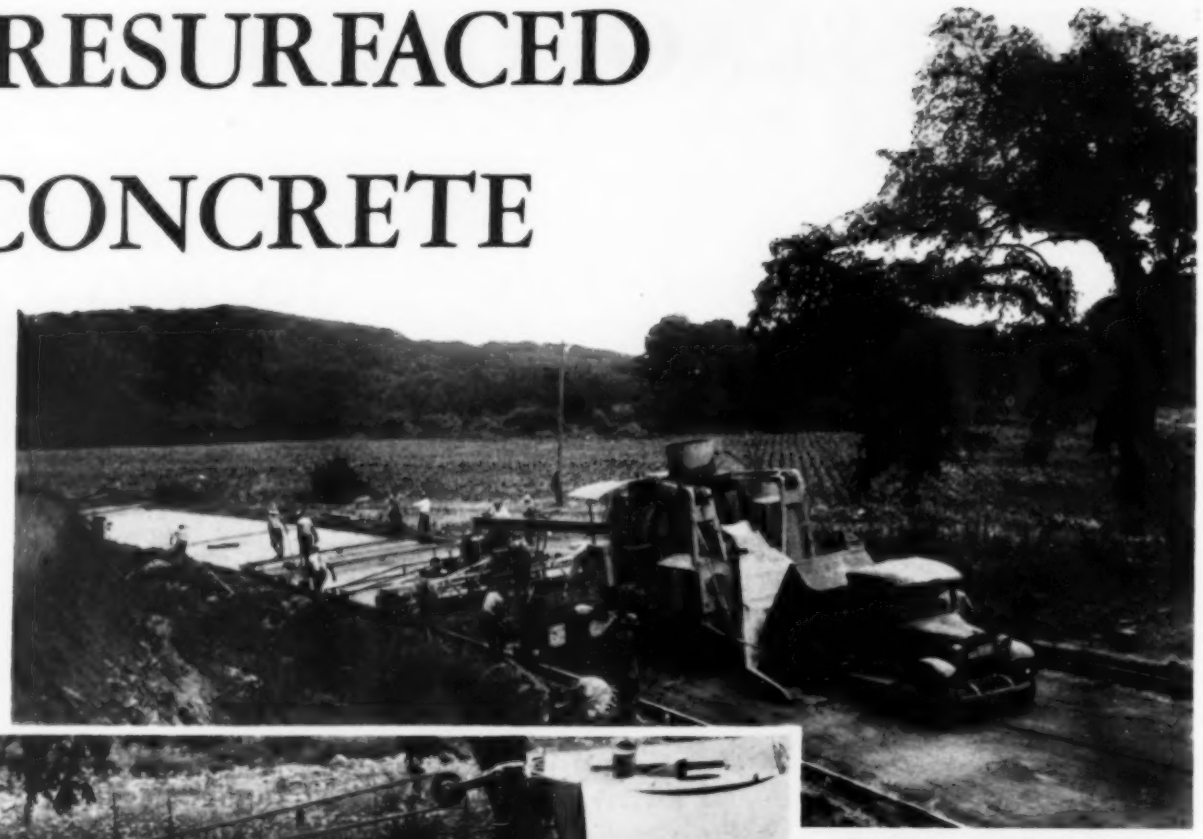
Fillet welds at the joints were built up in a number of beads to reduce the heating of the pipe metal at each step in the process. As shielded-arc welding is performed with a covered electrode which deposits a slag protective coat on the hot metal, the welding crew was careful to clean each bead with peen hammers and brushes before starting the next weld.

A well planned procedure and thorough preparation for the work resulted in good progress in actual fabrication on the building. Assembling and welding pipe sections in place offered advantages in safety and ease of handling over erection of the entire unit intact.

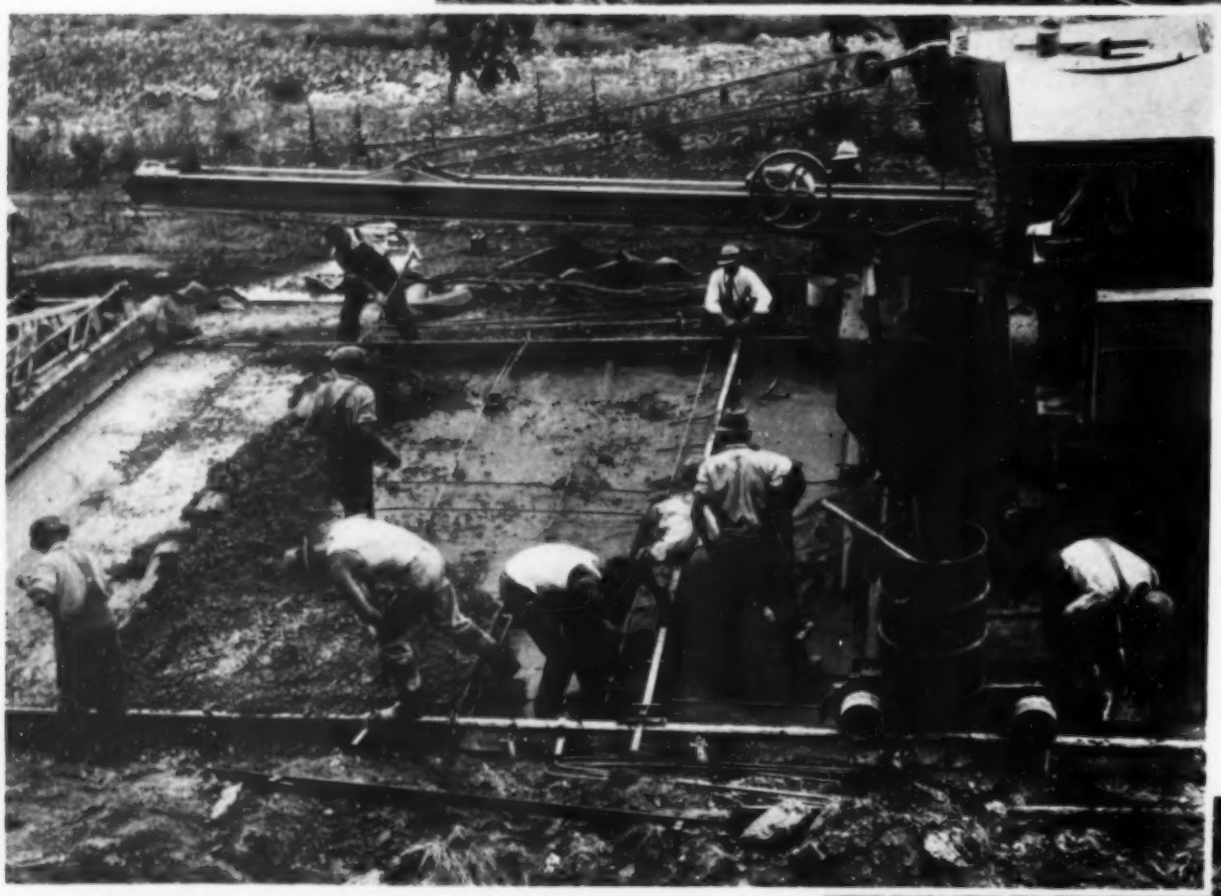
WELDED JOINT *(left)* between telescoped pipe sections consists of fillet weld built up in number of beads and eight plug welds through holes in wall of lower section. Upper section rests on ring riveted inside lower section. Inside diameter of pipe sections reduces from 18 in. at bottom to 5 in. at top.

BRICK RESURFACED WITH CONCRETE

on Iowa Paving Project



TRUCKS deliver dry batches to paving mixer on 8.3-mi. improvement project in Iowa.

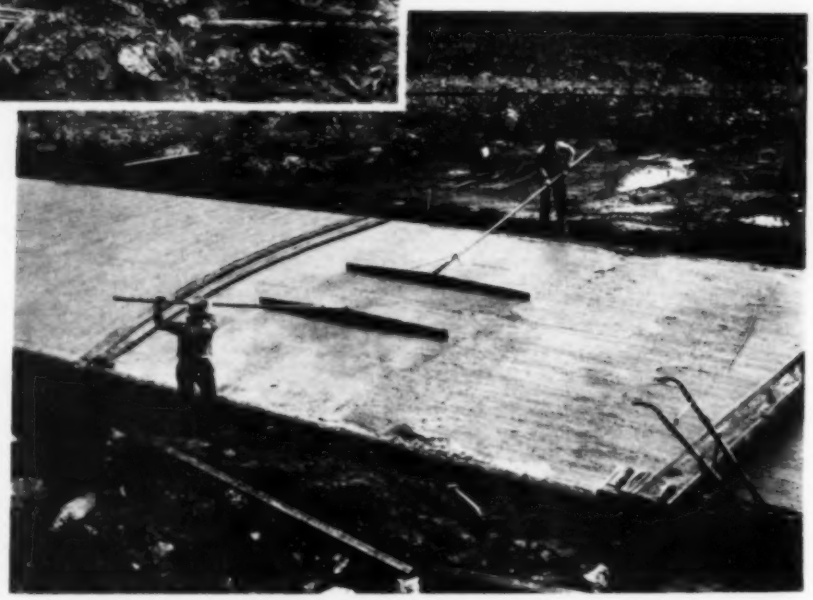


ON OLD BRICK SECTION being resurfaced with concrete, top and edges of brick course are covered with tar paper to prevent bond.

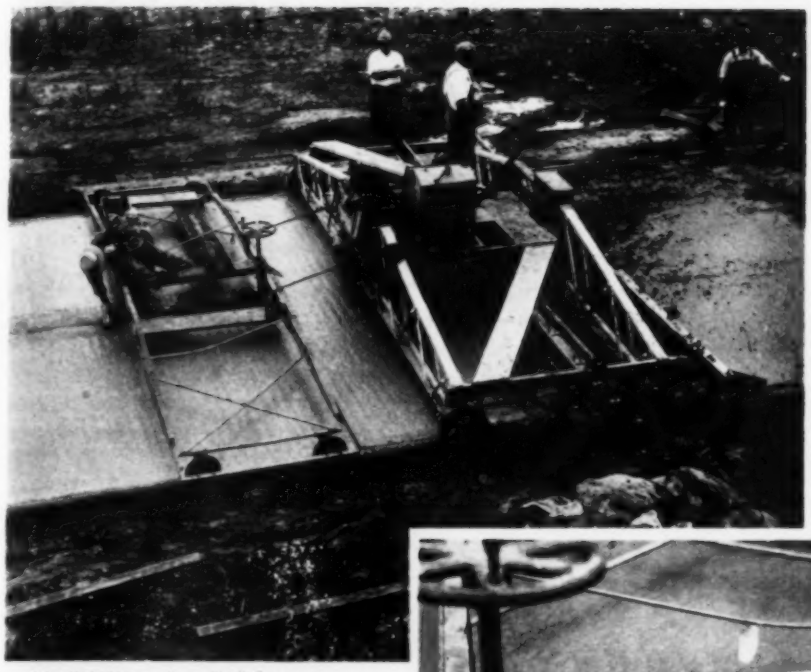
IOWA recently completed resurfacing with concrete 9,600 ft. of old pavement on U.S. 55, north of Dubuque. The old pavement, built in 1917, was 4-in. brick on a 4-in. concrete base. As reconstructed, the pavement consists of 6 in. of reinforced concrete on top of the brick surface, with concrete shoulders 1 ft. wide and 13 in. deep increasing the old 18-ft. width to 20 ft. The total length of the project was 8.3 mi. Of this length, 6.5 mi. was built according to the state's standard 10-7-10-in. cross-section 20 ft. wide, laid on natural soil.

U.S. 55 carries traffic from Dubuque to Minneapolis and, in Iowa, is the first north-and-south highway west of the Mississippi. It is one of the most beautiful routes in the Middle West, traversing the valleys made by creeks and rivers that have cut through the sandstone and limestone bluffs to reach the Mississippi, 300 ft. below. Only a short stretch of U.S. 55 in Iowa, and a few miles in Minnesota remain unpaved. When completed, this route in connection with U.S. 20 will form the shortest all-concrete highway from Chicago to Minneapolis.

Improvement Project—Resurfacing of the old brick was made necessary by drainage conditions. At the Dubuque end the road skirts the base of the bluffs and is largely founded on talus. During heavy rainstorms run-off from the hills flooded the pavement and impeded traffic to such an extent that 18 new culverts were planned to carry water to the low side of the roadway. In addition, a new bridge was to be constructed requiring an 1,100-ft. relocation of the highway, and a grade separation carrying the highway over the Great Western tracks required another 3,900-ft. relocation. As the pavement would have to be torn up at the location of each new culvert, it seemed



LONG-HANDLED STRAIGHT-EDGES scrape laitance and excess mortar off surface of fresh concrete slab.



MACHINE to install cleft-type center-line contraction joint is pulled forward by finishing machine.

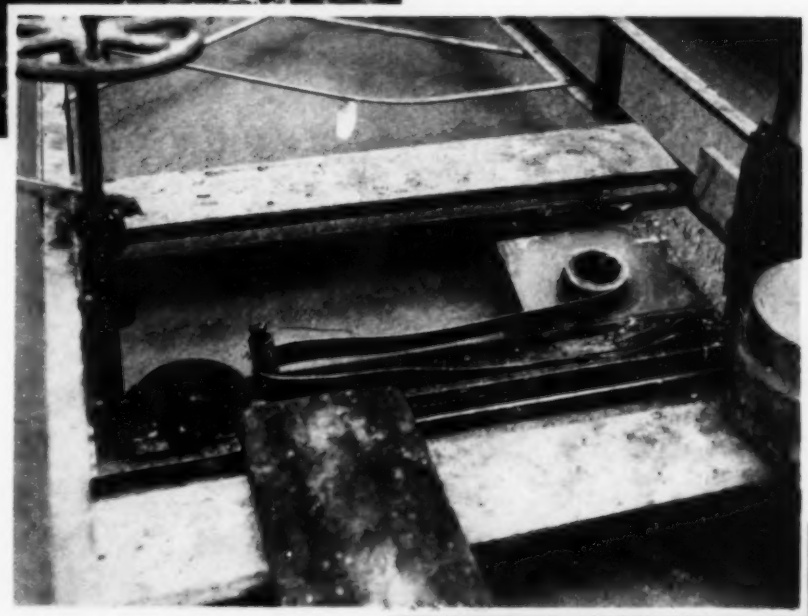
best to avoid these many patches by resurfacing the brick pavement with the material that was to be used in paving the relocations and the rest of the highway.

Resurfacing Procedure—The resurfacing was constructed by digging trenches along each edge of the old slab, in which side forms were set for the new concrete shoulder. The brick was swept clean and then covered with the tar paper that is used on all Iowa subgrades. This paper also covered the edges of the old slab to prevent bond between the new and old surfacing. A 4-in. layer of concrete then was deposited and struck off by a steel templet and the bar and mesh reinforcement was laid upon it.

Reinforcement for the resurfacing consisted of mesh weighing 44 lb. per 100 sq. ft. with ⅜-in. round U-shaped bars spaced 24 in. c. to c., along each edge, over the edge of the old slab. Tiebars, ⅝-in. in diameter and 4 ft. long, spaced 3 ft. c. to c., connect the two halves of the slab across the center joint, and ⅝-in. round dowels 2 ft. long, placed at 2-ft. intervals, extend across expansion joints.

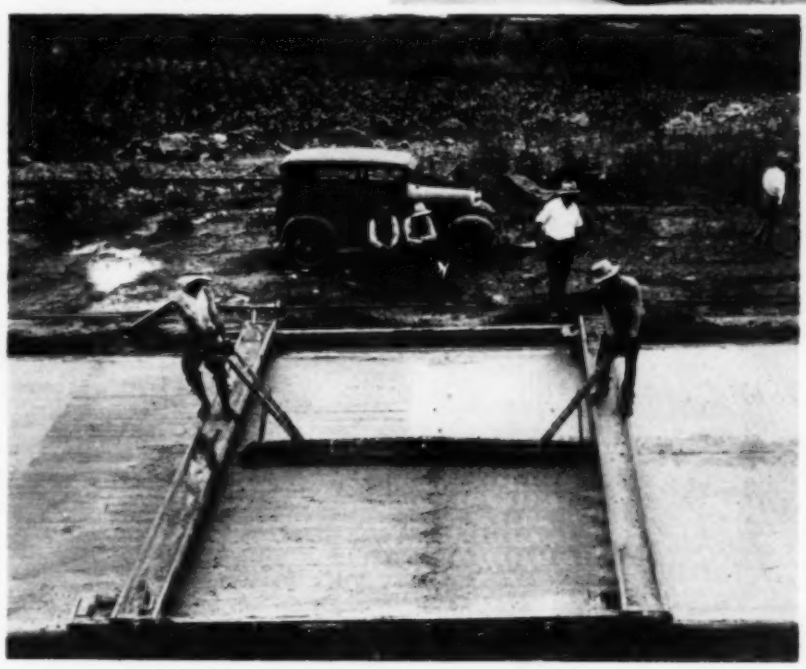
Joint Construction — Expansion joints ¾ in. wide were placed at 61½ ft. intervals. In the resurfaced section the old slab was cut out to a width of approximately 8 in. at each expansion joint. A strip of premolded expansion material 14 in. deep was set in this opening and concrete was placed about it, up to the top of the old brick. This concrete and the old brick were then covered with tar paper before the resurfacing was put on. The joint extended the full depth of both new and old slabs.

A dummy-type longitudinal center joint was formed by embedding in the concrete a strip of mastic 2 in. wide and about 1/16 in. thick. This strip was installed by a machine manufactured by the Flexible Road Joint Machinery Co., having a rectangular steel chassis with wheels that ran on the forms. A steel disk at the center of the machine cut a groove in the concrete when the machine was pulled forward, and a roll of mastic carried on a vertical spindle and looped over a guide roller ran into this groove in the slab. The mastic strip was held in the groove by a small wheel which rode on the upper edge of the strip, and the material was pulled from the spindle, as the whole machine moved forward, by friction between the mastic and the sides of the groove.



STEEL DISK on joint machine cuts longitudinal center-line groove in concrete into which is fed ribbon of mastic from vertical spindle.

LONGITUDINAL FLOAT *(below)*, removes transverse ridges from surface of pavement. Float is advanced half its length for each new passage.



Power to move the machine was furnished by the finishing machine which, at frequent intervals, fastened towing hooks to the framework to pull the device ahead.

As only one man was required to build it, this type of joint did not cost much. By keeping joint construction well ahead of subsequent operations, the joint machine avoided delays in finishing and installed the joint before the concrete had a chance to harden.

Finishing Operations—A longitudinal float was used as soon as the joint was completed. Following the float, laitance and excess mortar were scraped from the surface with straight-edges mounted on long handles. The final finish was given by two belts.

Drying out of the pavement during the curing period was prevented by a paint coat of asphalt emulsion. To prevent absorption of light rays by this black coating, with its resultant large volume change and excessive transverse cracking, the paint coat was covered with whitewash.

Costs—Standard 10-7-10-in. concrete pavement on this project cost the state $0.99 per square yard, exclusive of cement. The resurfacing course cost $6.50 per cubic yard, including steel and everything else but cement.

Cost of the overpass was $58,000.

WHITEWASHING EQUIPMENT is used to cover coat of asphalt emulsion applied to surface of concrete for curing, thus preventing absorption of light.

Total length of this feature of the project was 2,400 ft. from the toe of one approach to that of the other. Fill for the approaches required 45,700 yd. of earth, and 21,180 yd. of rock. The grading cost $32,000 and the structure $26,150.

Constructors—The Des Moines Asphalt Paving Co. was the contractor, and G. H. Doty was resident engineer for the Iowa State Highway Commission.

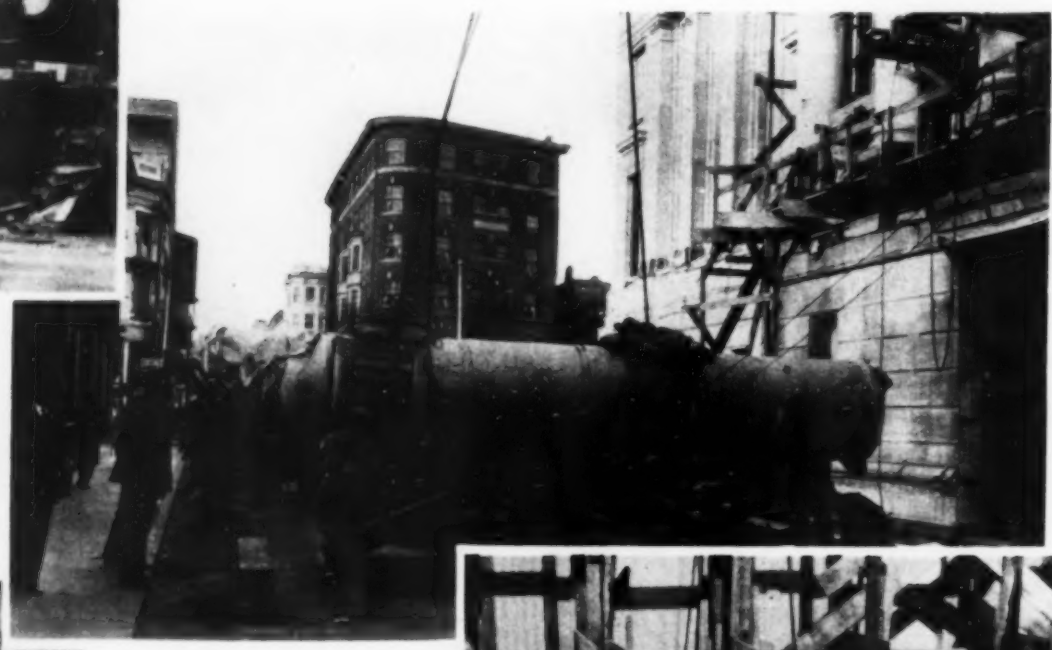
Step-by-Step

Erecting 15-Ton

WITH the aid of a special hoisting harness, a 35-ton steel guy derrick erected eight 15-ton limestone columns at the new building of the Christian Science Publishing Society, Boston, Mass., for which the Aberthaw Co., of the same city, is general contractor. The columns, 22 ft. long and 40 in. in diameter, were shipped on flat cars from which they were unloaded by a gantry crane.

Upon arrival at the building, the columns were lifted off the trucks in slings by the guy derrick. Belts of wood lagging placed around the columns protected the stone from damage by the wire rope. The derrick laid each column at right angles to the building on wood blocking directly under the final position of the stone, with the base of the column nearest the structure. A special harness consisting of two steel bands and a protective

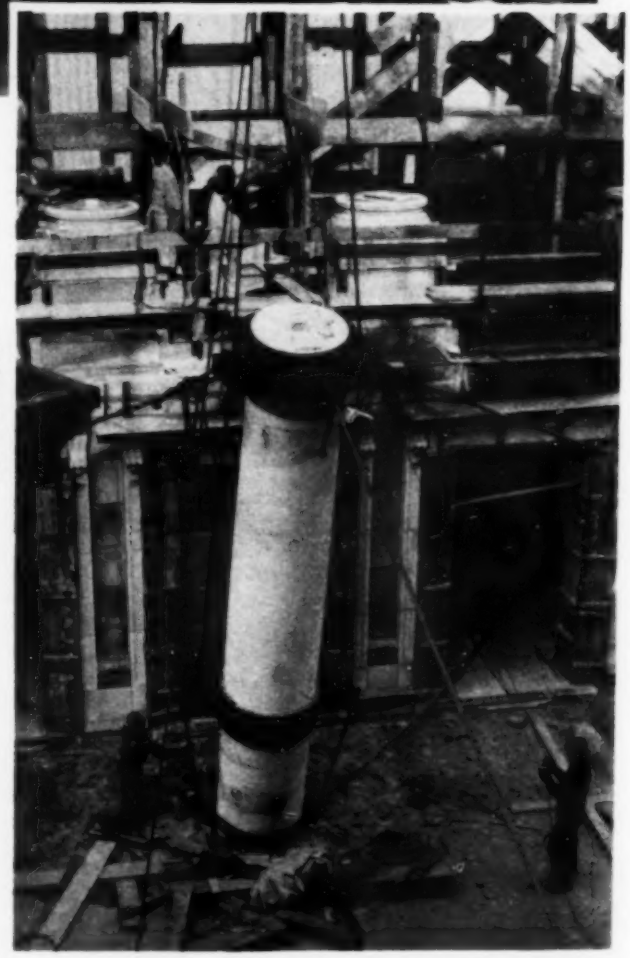
1 EIGHT 15-TON LIMESTONE COLUMNS arrive, two to each flat car. Traveling gantry crane unloads columns and places them temporarily on ground or directly on motor trucks.



2 AT BUILDING *(right)*, column is lifted from truck in wire-rope sling by derrick above. Belts of wood lagging protect stone against damage by wire rope.

3 AFTER DEPOSITING COLUMN ON WOOD BLOCKS *(left)*, erection crew attaches hoisting harness consisting of two steel bands and steel base plate, which covers lower end of column, nearest building.

4 WITH HOISTING BRIDLE ATTACHED TO HARNESS *(right)*, column slowly is turned to vertical position. Base of shaft, which rests in cushion of sand and excelsior, is kept from slipping by tackle carried back to curb.



Coming

Erection of 62 monolithic limestone columns weighing 60 tons each by a different method will be illustrated by a step-by-step article in an early issue of *Construction Methods*.

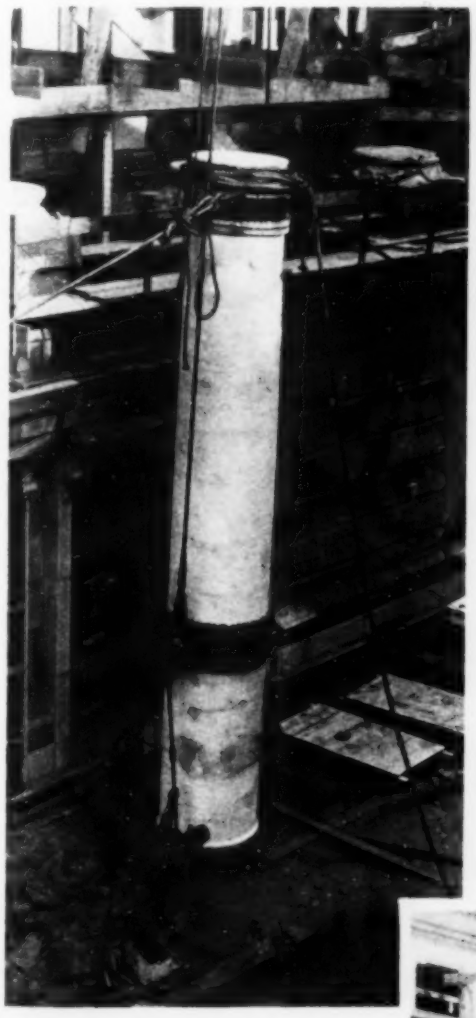
Field Methods

Limestone Columns

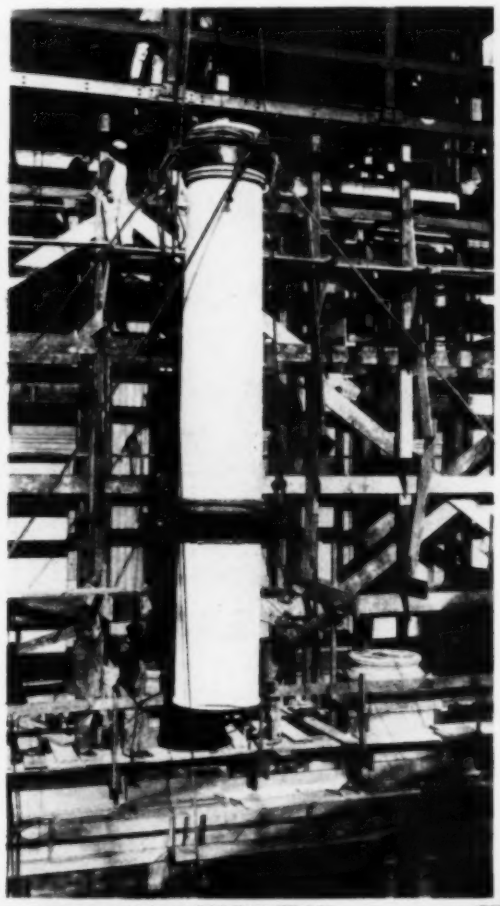
base plate was then attached to the column.

Cable ties connected the upper and lower steel bands and distributed the load between these holding devices when the column was lifted vertically. Turnbuckle ties from the base plate to flanges of the lower band held the plate in position. This plate protected a fillet at the bottom of the column while the stone was being up-ended. Hemp rope wrapped around the top of the column prevented damage, during setting operations, to a fillet at the upper end of the shaft. Accompanying photographs illustrate the steps of the erection procedure.

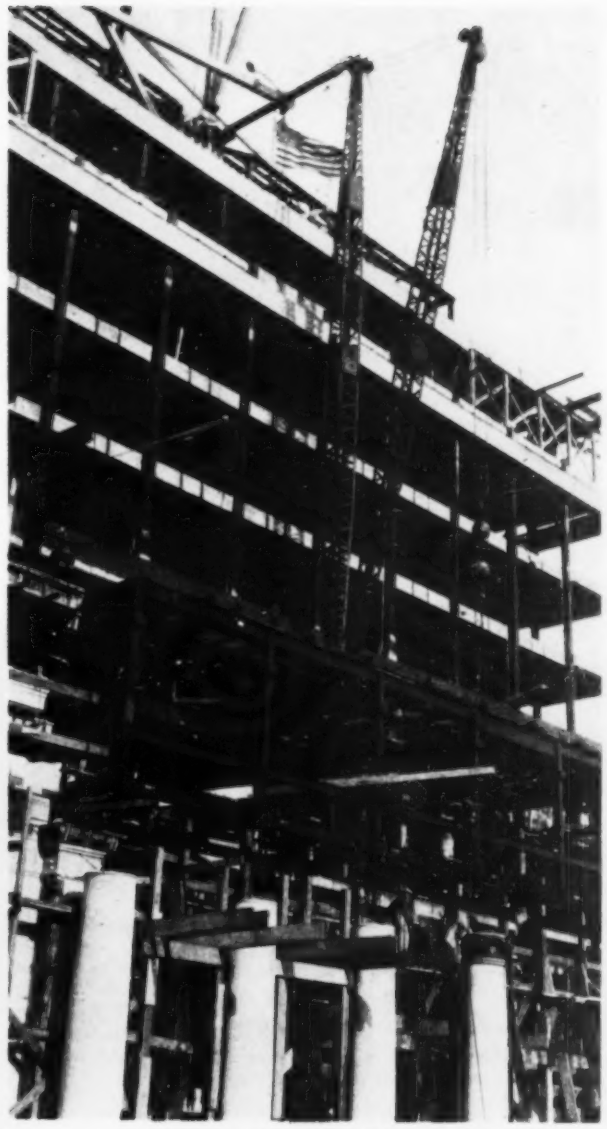
The building of the society, covering a city block 85x650 ft. in area, has a complete exterior facing of Indiana limestone. Chester Lindsay Churchill is the architect, with whom Lockwood Greene Engineers, Inc., is associated on structural design.



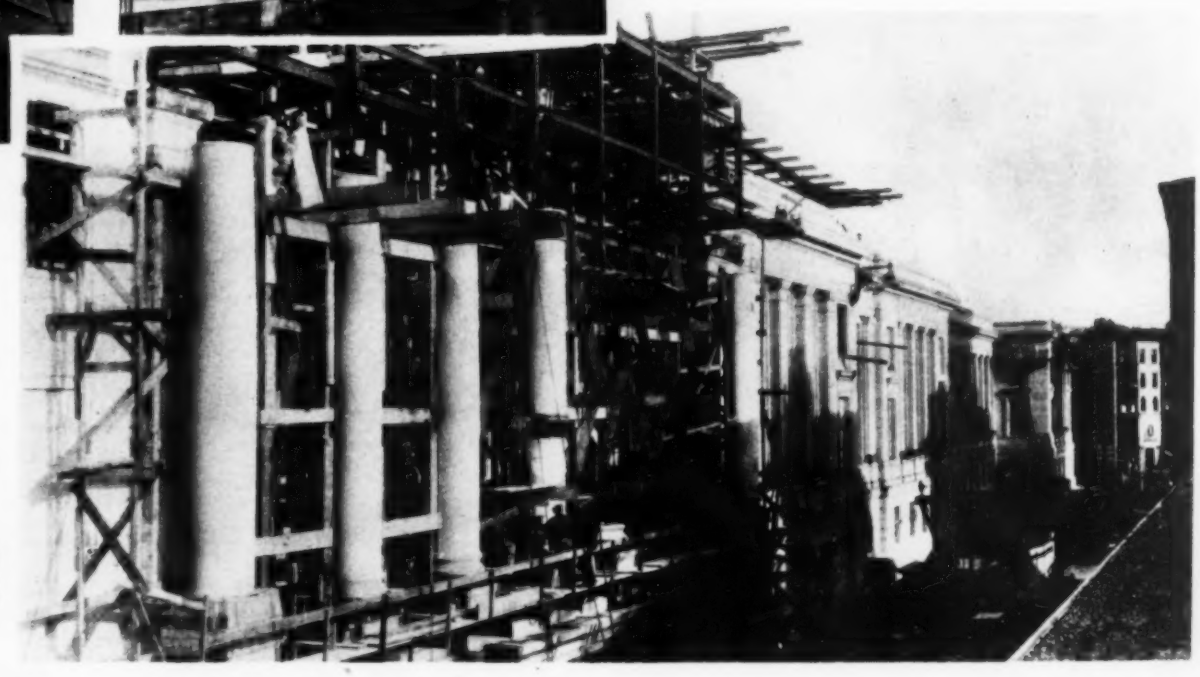
5 WHEN COLUMN IS CLEAR OF GROUND, workmen disconnect base plate and drop it from harness.



6 FREED OF BASE PLATE *(left)*, column is hoisted and moved horizontally toward final position on limestone pedestal.



7 35-TON GUY DERRICK erected on setback of steel frame unloads and hoists eight limestone columns to position.



8 FIFTH COLUMN of eight destined for this facade is raised and placed in permanent position. Harness then is unbolted and lowered for next shaft.

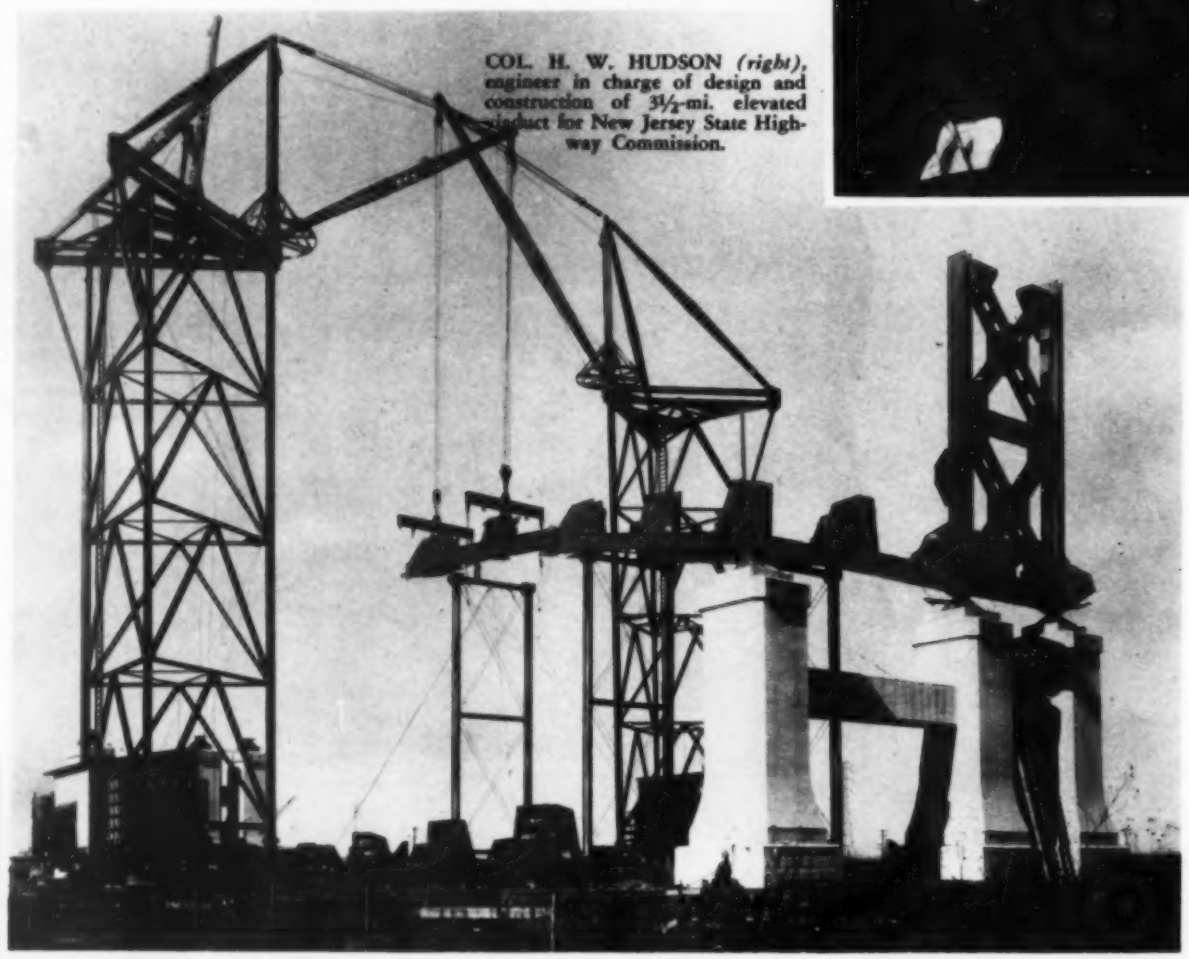
High-Level Bridge Offers Comparison of

THREE METHODS OF STEEL ERECTION

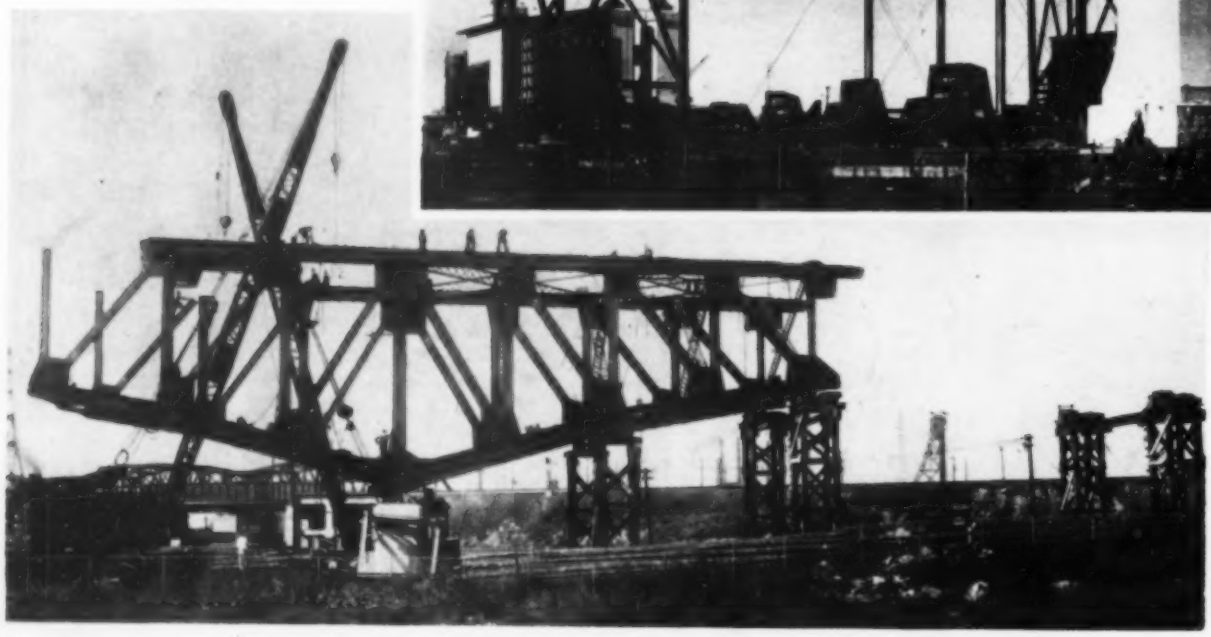
SOIL conditions along the right-of-way of the 3½-mi. viaduct, recently constructed by the New Jersey State Highway Commission across the meadows between Newark and Jersey City to provide a high-speed approach to the Holland Tunnels, largely influenced the choice of methods employed by structural steel erectors on the separate contract sections of the elevated highway. Variation in the bearing value of the soil, in combination with other important factors, persuaded the steel contractors to use different erection procedures. Their various methods and types of equipment offer a fairly broad exhibit of the best modern practice in truss-bridge construction. Operations on the land spans, which in general were of similar design, provided an unusual opportunity for comparative study of diverse methods.

Highway Viaduct—As briefly described in an article on the construction of the reinforced-concrete deck (*Construction Methods*, Jan. 1933, pp. 32-34), the high-level viaduct replaces an inadequate old road on the surface of the meadows and supplies a direct high speed link to the Holland Tunnels for traffic using the Lincoln Highway and other important roads to the west and south of Jersey City. The viaduct crosses the Hackensack and Passaic rivers on cantilever through-truss bridges with main spans 550 ft. long having a clearance above the water of 135 ft. Land sections of the new highway between the river bridges and to the east and west of the two streams consist in general of deck truss spans ranging from about 175 to 350 ft. in length and from 50 to 130 ft. in height. Bearings on the piers are alternately fixed and free, the alternate spans carrying suspended sections. Except where the structure is widened out to accommodate central ramps, the spans consist of two trusses; three or four trusses are used in the widened sections. All the deck spans have curved bottom chords, giving the trusses arch profiles.

COL. H. W. HUDSON *(right)*, **engineer in charge of design and construction of 3½-mi. elevated viaduct for New Jersey State Highway Commission.**



LOCOMOTIVE CRANES *(below)*, **traveling on tracks laid parallel with viaduct erect trusses on timber tower falsework bents. Towers of each bent are braced and tied transversely by struts and wire-rope diagonals.**



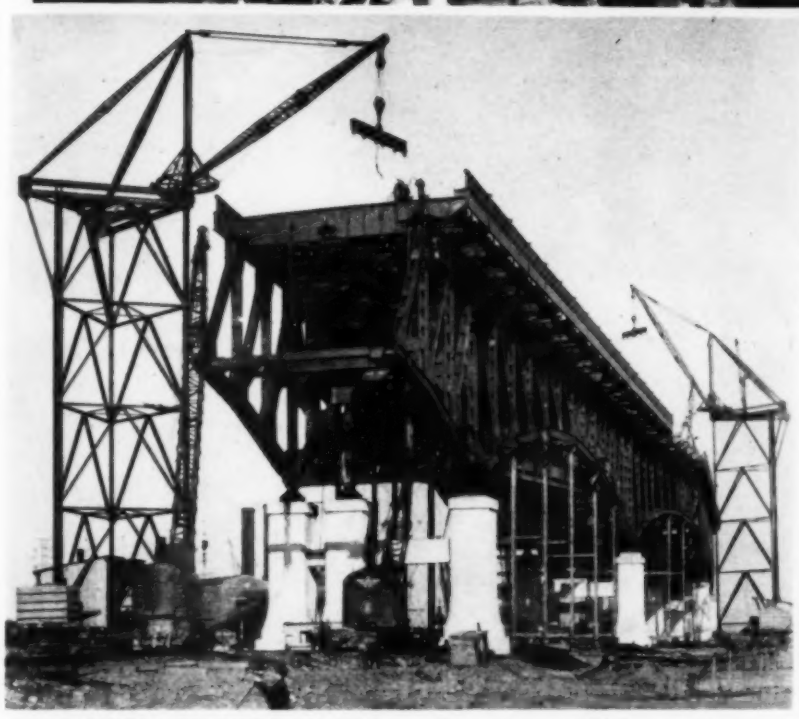
TRAVELING TOWER DERRICKS on two sides of structure erect trusses on H-section legs of steel falsework bents. Travelers place bottom chord on first pass between piers of anchor span.

McCLINTIC-MARSHALL SECTION

Both of the river bridges and nine of the seventeen deck truss spans connecting them were included in the section erected by the McClintic-Marshall Corp. Each of the cantilevered through truss river bridges required a total of 8,650 tons of stuctural steel. The two trusses are spaced 57 ft., c. to c., and the bridge structure has a total length of 1,250 ft. As already stated, the main span clearance above mean high water is 135 ft., and the highest steel is 208 ft. above mean high water. Anchor spans are 350 ft. long.

Steel Piles—Bethlehem 12-in. 65½-lb. H-sections were installed as steel piles to support the falsework under the anchor arms of both the Passaic and Hackensack River bridges. Steel

3½-MI. HIGH LEVEL VIADUCT carrying roadway 50 ft. wide eliminates need of movable spans at two navigable streams by providing 135-ft. clearance over channels. Except where central ramps occur, roadway is supported by two trusses resting on twin shafts of concrete piers.



FLEXIBLE CONTROL of erection operations is provided by traveling tower derricks which can be moved at will to any part of work. Locomotive cranes supply derricks with material.

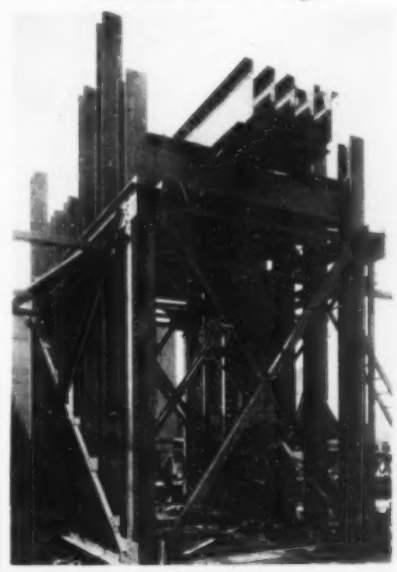
piling was chosen because extremely long lengths could be driven economically where great penetration was needed to develop adequate bearing. A foundation condition requiring long pile lengths was anticipated and realized on the west anchor arm of the Passaic River bridge. The steel piles, although especially useful here, proved to be of equal utility in the contrary condition encountered under the west anchor arm of the Hackensack River bridge, where they drove to refusal in hard material after penetration of from 0 to 4 ft. Steel frames, used as guides in driving, added to the economy of this operation and later acted as permanent bracing for the piles. The frames were moved as units without dismantling and were re-used under successive anchor arms.

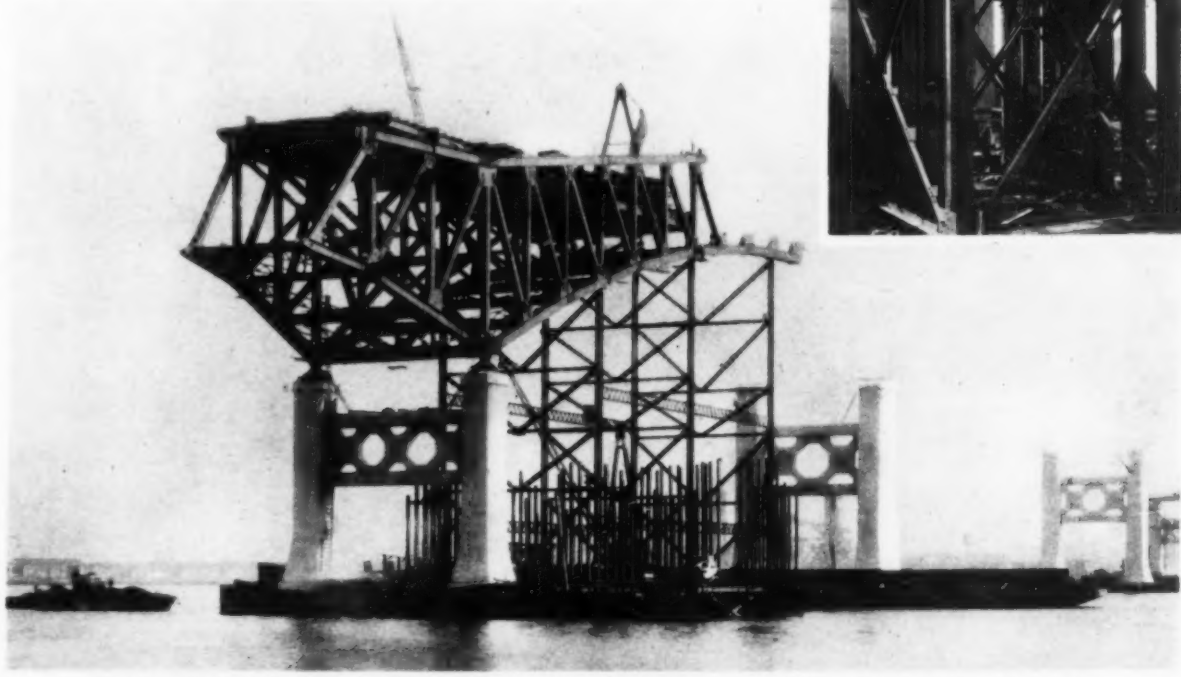
Erection of River Bridges — Erection started on the east end of the Passaic River span, which lies to the west of the Hackensack River bridge. A locomotive crane placed steel grillage pads for three of the falsework bents under the east anchor arm and drove clusters of 12-in. Bethlehem 65½-lb. H-sections for the fourth bent at the river's edge. Part of the steel falsework adjacent to the first pier was utilized as a platform for a guy derrick which erected an A-frame traveler on top. This traveler removed the guy derrick and proceeded westward, erecting steel falsework bents, with the aid of the locomotive crane, and steelwork to the center of the main span.

All of the steel for the east anchor arm was delivered on two temporary tracks on the ground directly under the span, and was unloaded either by the locomotive crane or by the A-frame traveler on top. The steel from the main pier to the center of the river was delivered by car float and was picked off and set by the traveler. A gasoline crawler crane, placed on the bridge floor by the traveler, followed the traveler erecting the railing and the top lateral system.

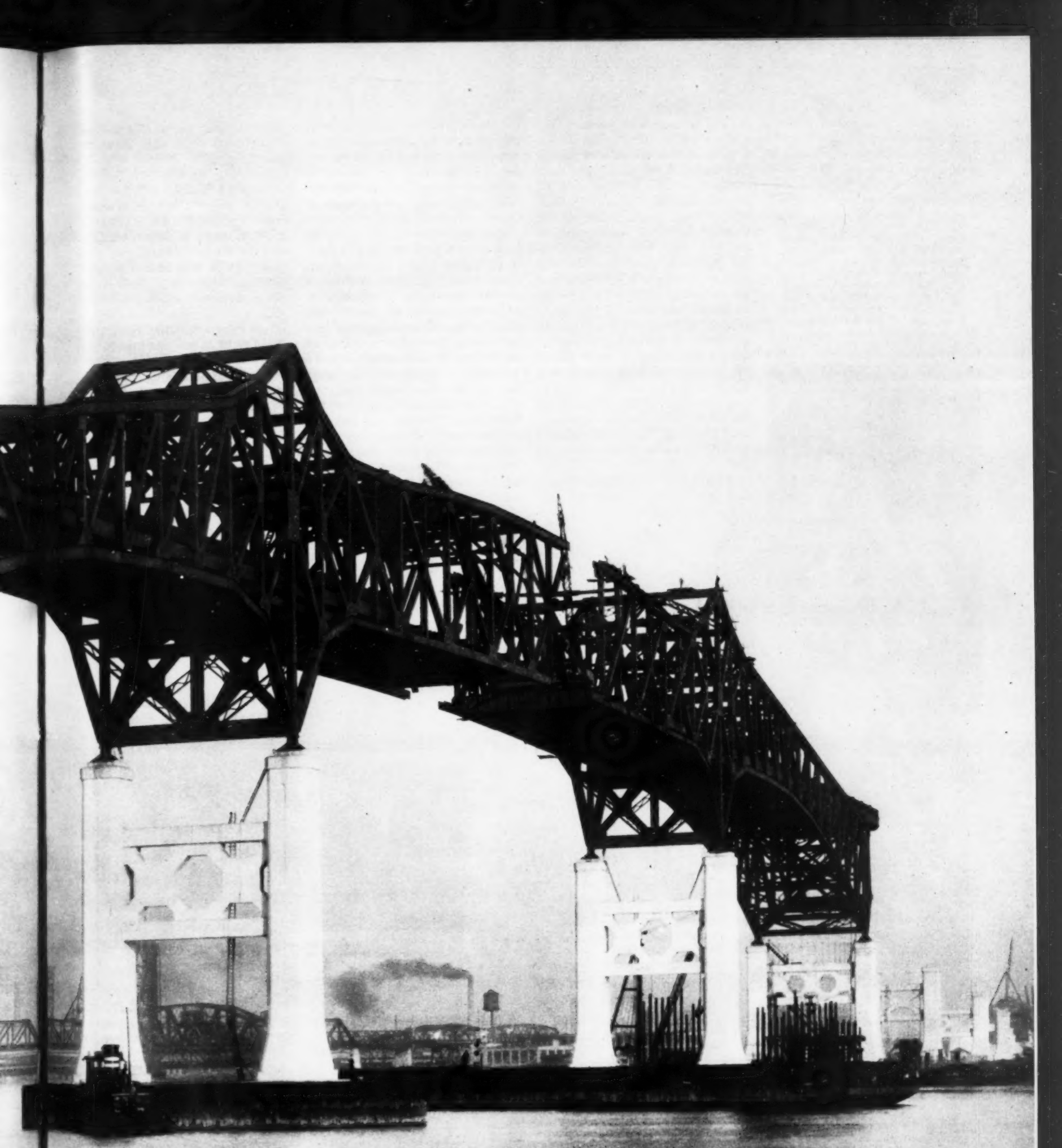
These operations were repeated for the erection of the west half of the Passaic River bridge, with the exception that 12-in. H-section steel piles were used under each falsework bent, because of the nature of the ground. The same guy derrick and crawler crane served the erection of this half

STEEL H-SECTION PILES *(below)* driven in steel guide frame form bearing for one leg of falsework bent at river bridge.





STEEL FALSEWORK bents under anchor arms of river bridges rest mainly on clusters of steel H-section piles driven with aid of steel guide frames which later serve as bracing for piles.

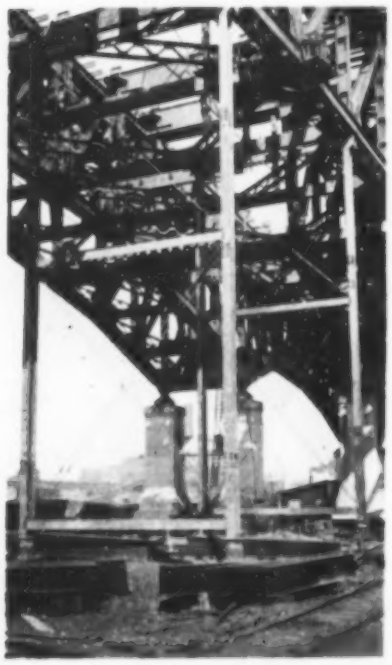


HACKENSACK RIVER BRIDGE, forming part of [illegible]. High level viaduct across New Jersey meadows between Newark and Jersey City, is one of two duplicate cantilever structures having 550-ft. anchor spans and 550-ft. main spans with clearance of 135 ft. above channels. Two A-frame travelers, erected by guy derricks on deck above end piers of anchor arms, carry steel erection forward until they meet at center of suspended span. Both travelers pick all steel for this bridge. Trusses are floated in river. Crawler cranes, following travelers, erect railing and toy lateral system. Falsework bents under anchor spans have been removed, but several clusters of steel H-section piles remain to support falsework remain under east span, in background. Contractor: McClintic-Marshall Corp., Bethlehem, Pa.

of the bridge, but a second A-frame traveler was used.

Similar methods were followed in erecting the Hackensack River span. All falsework bents at this bridge rested on steel piles driven with a derrick float. Work started on the west anchor

FALSEWORK BENTS *(below)* having steel H-section legs, one under each truss, rest on sand jacks which are released to connect suspended span. Bents are set above final grade to provide for settlement.



arm, using the guy derrick from the west section of the Passaic River bridge and the A-frame traveler from the east half of the bridge. A third A-frame traveler erected the steel on the east Hackensack span. All steel for the Hackensack River bridge was lifted directly from car floats which were loaded at a ground storage yard.

Deck Truss Spans—Deck spans in the McClintic-Marshall contract connected with the east end of the Passaic River bridge. To deliver steel for these spans, a temporary track was laid on the ground the entire length of the work under the center line of the bridge. Steel in the nine spans, which have a total length of 2,535 ft., aggregated 12,400 tons. The longest span is 335 ft., and the maximum height of the steel above the ground is 120 ft. A portion of a ramp connecting the elevated highway with Jacobus Ave., Kearney, was included in this section.

Locomotive cranes set steel grillage pads and steel falsework. The latter consisted of H-section columns K-braced transversely by laced channels and stiffened longitudinally by the lower chords of the trusses. In general, two bents were used per span. The A-frame traveler from the west end of the Passaic River bridge was moved forward to the east end for the erection of these spans. It erected the structure complete as it advanced, lifting the major portion of the steel directly from cars below. Ramp girders, 144 ft. long, weighing 62 tons each, were delivered by cars and erected by combined efforts of the traveler on top and a locomotive crane on the ground. The falsework bents were adjusted vertically by hydraulic and steel wedge jacks.

Work of the McClintic-Marshall Corp. was performed under the general supervision of G. P. Bullard, manager of erection. Operations in the field were directed by A. F. McLane, resident engineer, and E. A. Proctor, assistant resident engineer, with W. E. Omohundro and H. G. Reynolds as foremen.

AMERICAN BRIDGE SECTION

Exclusive of a through truss bridge over the tracks of the Hudson & Manhattan R. R. and the freight tracks of the Pennsylvania R. R. at the east end of this section, the work of the American Bridge Co. consisted of nineteen deck truss spans. The contract involved about 23,000 tons of steel.

Erection Program—Two railroad tracks were laid parallel with the line of the bridge, one on either side. Cars loaded with steel at the fabricating plant were switched to these tracks, and the major portion of the main steel for fifteen of the spans was lifted directly from the cars to its position in the structure by locomotive cranes. Four spans at the west end of the section were too high for erection by locomotive crane, and the steel for these spans, therefore, had to be placed by a deck traveler.

Five locomotive cranes of 60-ton capacity, equipped in general with 85-ft. booms, erected the main arch trusses and enough of the floor beams and bracing to stiffen the structure until a traveler working on the deck could fill in the remaining floor steel and bracing. This traveler erected all the steel in the four high spans at the west end of the section, connecting with the Hackensack River bridge.

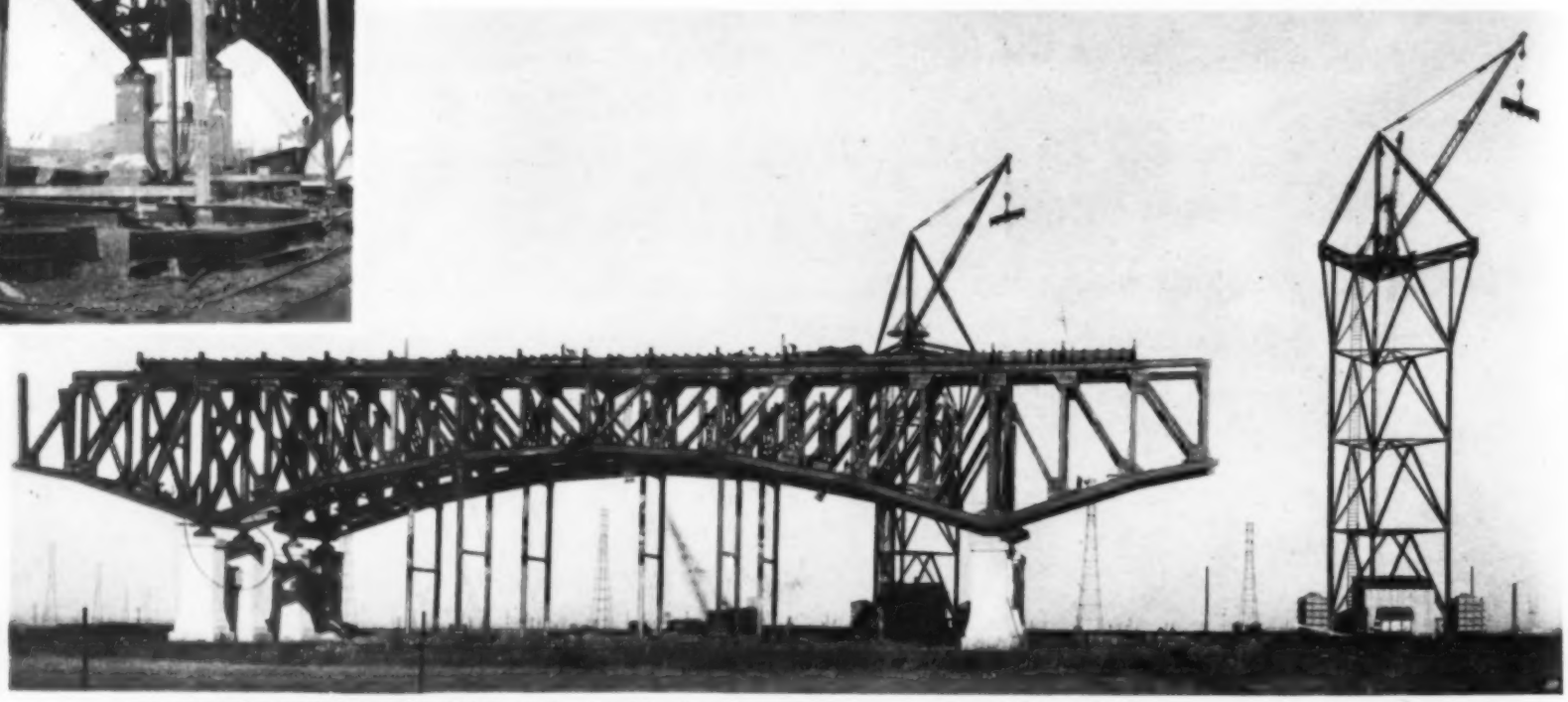
Anchor spans were erected first, followed by the suspended portion of the intermediate cantilevered span. In erecting the suspended portions of a few spans, each truss, weighing about 60 tons, was assembled on the ground and lifted to place by two locomotive cranes. On other suspended spans, the suspended portion was divided into two halves which were joined on a center falsework tower. Where two bents were used in a suspended span, the east half of the span was cantilevered to the first bent, and steel was erected continuously from this bent to the second bent and finally to the pier.

In the general process of erecting an anchor span the locomotive cranes first placed the bottom chords and bottom laterals and then filled in the web members and top chords in the two ends. The center section of the span was assembled last.

Falsework consisted of timber-tower bents braced by diagonal wire rope ties. With the exception of six spans near the center of contract section, where timber piles were required, all falsework towers rested on mud sills. In general, three or four bents were used under each anchor span and one or two bents under each suspended span.

Between spans 9 and 17, the two-truss viaduct widened to a four-truss structure, about 90 ft. wide, to accommodate a central ramp. In erecting this four-truss section of the viaduct, falsework first was placed for the two south trusses, which were erected complete by a locomotive crane. The falsework then was moved to the north side where two locomotive cranes erected the last two trusses. The deck traveler placed the floor steel and bracing, and erected all the ramp steel.

As many as 32 riveting gangs worked at one time on the structure, using a pressure of 135 lb. at the riveting hammers. Two compressor plants supplied air for the hammers. One, at the east end of the section, had three oil-engine compressors with a total capacity of about 1,000 cu.ft. per minute. Another compressor plant, under span 15, equipped with one stationary oil-engine compressor and two portable gasoline-engine compressors, supplied about 700 cu.ft. per minute. Booster pumps forced the air up to the deck and along a pipe line to receivers installed at intermediate points along the structure.



TO PROVIDE FOR CENTRAL RAMP, viaduct is widened to four-truss structure, and steel falsework bents are arranged under each pair of trusses. Following erection of two anchor spans, intermediate suspended span is erected on similar bents.

Erection operations of the American Bridge Co. were directed by J. B. Gemberling, eastern division erecting manager, with Sam McQuarrie as foreman and D. F. Fine as resident engineer.

PHOENIX BRIDGE SECTION

Eight spans connecting with the west end of the Hackensack River bridge were erected with traveling tower derricks by the Phoenix Bridge Co. This section has a total length of about 2,400 ft., with a maximum span length of 325 ft. and an average span length of 297 ft. Maximum height of structure above ground is 128 ft.

A central ramp in this section caused a decided variation from the two truss cantilevered construction. To provide for this ramp, the width of the structure was increased to include some spans with two trusses, some with three trusses and some with four. The varied character of the structure played a substantial part in shaping the contractor's final dicision to use ground travelers for erection.

Ground travelers provided great flexibility in erection procedure and eliminated the need for erecting equipment on the deck, making it possible to use light falsework supporting the structural steel only. The ground in many places along the right-of-way was soft and unsatifactory for the support of heavy loads. Use of tower travelers practically obviated the danger of settlement. As a final advantage, track work for the travelers was done on the ground, where it could be performed more rapidly with ordinary labor and at less risk to the men.

All of the steel in this contract section, aggregating 17,800 tons, was erected by the tower travelers, with the exception of the suspended span connecting the first shore span with the Hackensack River bridge. As this suspended span was over the water, it was erected by a light deck traveler.

Each of the two ground travelers operated by the contractor consisted of a triangular steel tower 142 ft. high, from top of rail to heel of boom, equipped with a 40-ton stiff-leg derrick having a 75-ft. boom. The tower was mounted on four standard-gage steel trucks which traveled on a pair of tracks spaced 28 ft. 7 in., c. to c., two trucks running on an inside track close to the structure and the other two on the outside track. To take care of heavy side lifts on the derricks, each tower was counterweighted at the bottom, and the moving load of each unit fully equipped was 225 tons.

Power for the derricks was supplied by a Lidgerwood 3-drum 10x12-in. steam hoist engine located in the base of the tower. The towers propelled themselves along the track as desired by means of a set of double blocks reeved with 1½-in. rope. By this arrangement it was possible to move the tower the full length of a span in about 5 min.

Structural steel was supported on steel falsework bents with one H-section leg under each of the trusses. The steel bents were stiffened transversely by struts and wire-rope diagonal bracing and longitudinally by the bottom chords of the trusses. Five falsework bents were installed to support each anchor span of the cantilever construction, and three bents were used under each suspended span. The bents were supported on sand jacks resting on timber grillage footings. The general procedure was to set the falsework bents considerably above the required elevation to provide for settlement and obviate the need for raising the bents.

Erection Procedure—Two locomotive cranes, one for each traveler, supplied the derricks with material. Starting erection at the fixed end of an anchor span, the derricks placed the falsework bents, bottom chords and bottom laterals complete between the piers of this span. On the return movement of the traveler, the web members were placed, or in some instances the web members, top chords and top laterals. In general, a third movement completed the erection of the floor and railing. The arrangement was so flexible and the traveler was so easily moved that the program could be varied at will without any sacrifice in efficiency.

A-FRAME TRAVELER erects deck truss spans, lifting steel from gondola cars below. Locomotive cranes set steel grillage pads and falsework bents.

After two anchor spans had been erected, the suspended span between them was erected in a similar manner on three falsework bents. The spans were connected by slacking off on the sand jacks. In many cases when the falsework bents had been completely released, it was possible to remove them without dismantling and to carry them forward to the next span. Because of the decreasing height of the structure caused by the down grade of the roadway, it was necessary to reduce the length of the legs in some bents at each move. This change was made by removing spliced sections of the column legs, which were specially designed to fit these conditions.

J. F. Kinter, superintendent of erection, had general supervisory charge of field operations, which were carried out under R. S. Foulds, engineer of erection. W. C. Bearse was foreman, and Frank W. Peirce, resident engineer.

TAYLOR-FICHTER SECTION

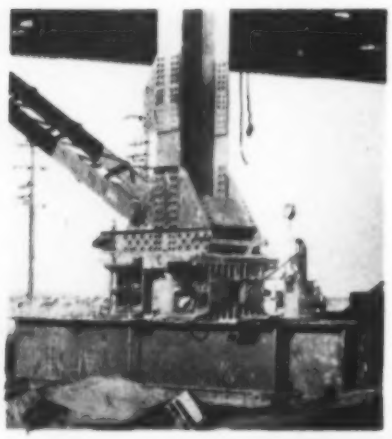
In addition to a half-mile section including four truss spans and a number of plate girder spans at the east end of the viaduct, on which it acted as subcontractor under Charles T. Kavanagh, of Bayonne, N. J., the Taylor-Fichter Steel Construction Co. had a direct contract with the state highway commission for another section about ½ mi. in length of typical deck truss spans. This latter section consisted of eleven spans of cantilevered construction, each about 200 ft. long, connecting with the west end of the Passaic River bridge. The structure ranged in height from 120 to 50 ft. and involved the erection of 9,100 tons of steel. At one point on this section a ramp takes off from the north side of the viaduct providing a connection with streets in Newark.

For various reasons, the contractor decided to erect all the spans of this section by the cantilever method, using a deck traveler. This method required that the suspended spans be converted for purposes of erection to simple spans, but it reduced the amount of falsework necessary to one bent per span. A reduction in the amount of falsework was essential under one span which crosses Raymond Boulevard, (old Lincoln Highway) where dense traffic conditions forbade obstruction of

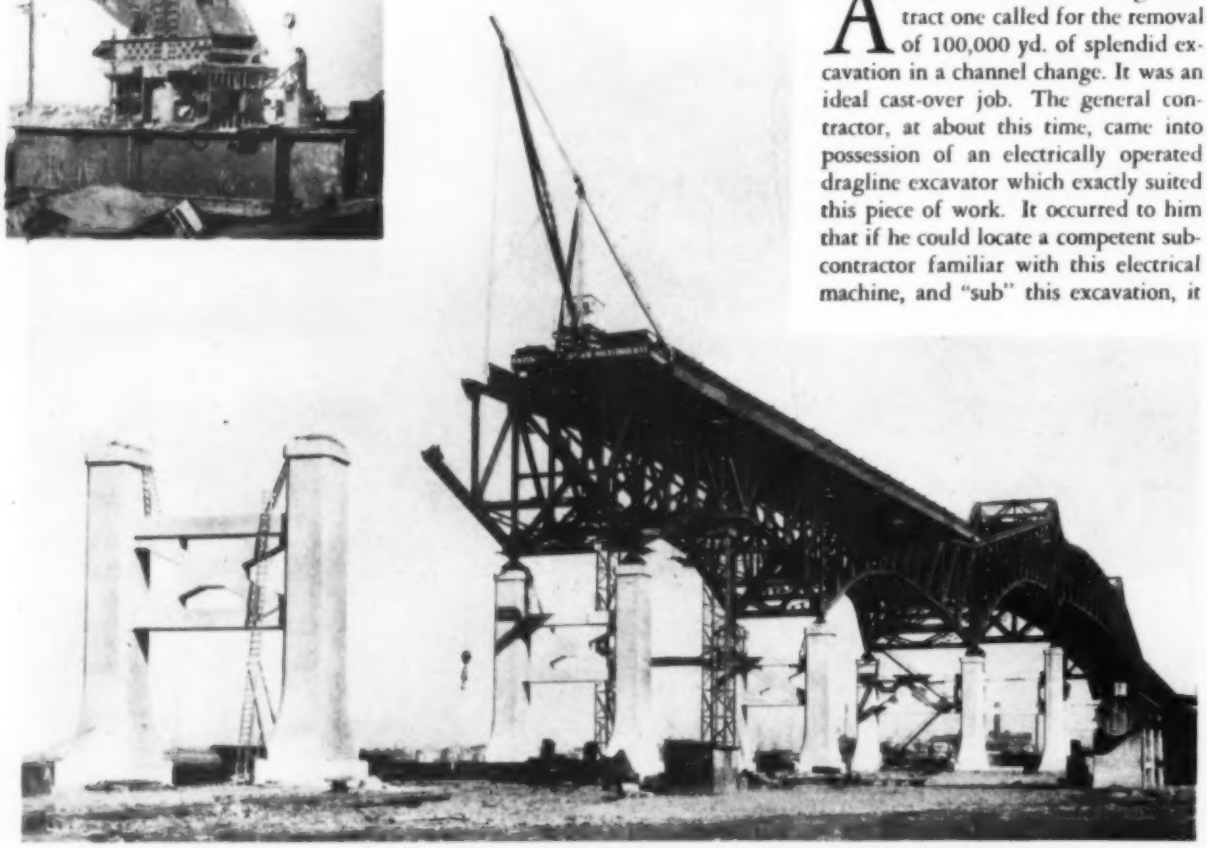
STEEL TOWER FALSEWORK BENT *(below)* **resting on timber pile foundation is sole intermediate support of deck truss span during erection. Suspended spans are made into simple spans to permit this cantilever method of erection, which saves in number of falsework bents and piles.**

travel. Use of but one falsework bent per span in all cases meant a saving in the number of piles that had to be driven.

Each span consisted of two arch trusses, and the falsework bents were made up of two steel angle towers, one under each truss, braced transversely by steel struts and wire rope diagonals. The towers were designed to facilitate shortening as the height of the structure decreased. Two 200-ton hydraulic jacks installed on the tops of the towers were used to take up any settlement and to release the falsework when the structural erection had been completed.



HYDRAULIC AND STEEL WEDGE JACKS *(left)* provide vertical adjustment in falsework bents.



CANTILEVER METHOD of erection by deck traveler reduces falsework to one steel tower bent per span but requires that suspended span be converted to simple span for purposes of erection.

Erection Procedure—A derrick traveler with a capacity of 45 tons and a boom 90 ft. long was erected on the deck at the west end of the Passaic River bridge. The traveler proceeded from this point westward, erecting each span complete as it advanced. A gasoline crawler crane with a 90-ft. boom on the ground assisted the deck traveler in setting lower chord members of the trusses. All steel was delivered by trucks using a temporary road along the right-of-way. The crane unloaded the steel and placed the falsework towers. Only one falsework support was used under each of the spans erected by the 45-ton derrick.

At a later date a second traveling derrick with a narrower base and a shorter boom was installed on the deck at the west end of the section. This traveler worked east, erecting several spans by the cantilever method, with two falsework bents instead of one being used as supports during erection. The main purpose of the second traveler, and the reason for its being made smaller in size, was to erect the deck girder spans of the Newark ramp.

The two travelers met at the head of this ramp, and the smaller derrick turned down the Newark connection, erecting steel as it proceeded. One of the ramp spans crosses the electrified Waverly Branch of the Pennsylvania R. R., and the plate girders of this span had to be placed by the traveler below the high-tension transmission lines.

J. Lowenstein, president and chief engineer, was in general charge of the work for the contractor, assisted by H. O. Adelman, designing engineer, Samuel Kapelson, general manager, John Grandan, foreman, and A. Krohn, resident engineer.

Administration—Hugh L. Scott is chairman of the New Jersey State Highway Commission. The Holland Tunnel approach viaduct was constructed under the general direction of Jacob L. Bauer, state highway engineer, of all office and field work, assisted by S. Johannesson, designing engineer, H. W. Hudson, was engineer in charge and H. R. Gabriel, field engineer.

Helps to Successful Contracting

Eighth of a series of articles on applying business principles to construction and making profits by avoiding costly mistakes

By HARRY O. LOCHER
Contractor, New York

VIII — Subcontractors

AMONG the items on a large contract one called for the removal of 100,000 yd. of splendid excavation in a channel change. It was an ideal cast-over job. The general contractor, at about this time, came into possession of an electrically operated dragline excavator which exactly suited this piece of work. It occurred to him that if he could locate a competent subcontractor familiar with this electrical machine, and "sub" this excavation, it might be the most advantageous way to handle it. After considerable inquiry a certain man was recommended to him. A meeting was arranged and finally an agreement entered into for "subbing" the work, an ideal, tailor-made dragline job.

A Lucky Start—There was little for our newly born subcontractor, a former electrical worker, to do but hire three capable dragline operators, a few laborers, and start work. The general contractor furnished him the machine, took care of his payrolls and all other expenses. Due to the high class supervision of the general contractor, the simplicity of the work itself, and the loyalty, dependability and competency of the three operators, the work was completed in a surprisingly short time and with results most gratifying to both general and subcontractor. In an ideal situation like this the results obtained were inevitable.

Luck often follows luck—for a while. Our erstwhile electrician—now a full-fledged contractor—succeeded in getting another ideal dragline cast-over job. He succeeded, again, in procuring an electrical machine well suited for this new work for an almost insignificant initial and ultimate cash consideration. This job, too, was successful. Our new contractor basked under his lucky star. For a while he enjoyed his undreamed-of cash and glory. Then he sought new fields to conquer.

The Real Test—A 700,000-yd. excavation and embankment job was up for bids in a far distant state, and in a climate and under conditions totally foreign to our new earth mover. But these facts did not worry him. Nor did it occur to him that he was still in his swaddling clothes as a contractor. He bid the job and was low. In passing, let us give him credit for initiative and a persuasive personality. In order to qualify and be financed and to secure his equipment, he sought assistance from the contractor who had helped him on the first job. Influenced by results of similar work which he had done in the past, under most competent management, and by the results of the two jobs done by this subcontractor, he concluded he was perfectly safe in extending aid to get this new work started in return for an interest in the contract. Somehow, our new contractor had neither funds nor equipment available for this new work, although he agreed to furnish part of both for the new job.

Funds and equipment were sent him and things got started. Little had been accomplished before a flood covered the entire work. Then, when work was resumed, the open field part of it was soon completed and the right-of-way hit the heavy timber—and it *was* heavy and the right-of-way was long and wide. Malaria struck the camp. Men were hard to get, and this, that and the other thing occurred. The progress

being made was so miserable that the principals threatened to take over the work and complete it with their own forces. Our dragline wizard was up against some of the stuff that constitutes the acid test for real contractors. He began to weaken. Dragline work in this desolate location amid giant trees, bad water, far away from the railroad, with a serious scarcity of men and a malaria ravaged camp, was a different proposition from running a dragline along a lawn up in God's country. His lucky star began to dim.

To make a long and pathetic story short, under compulsion from the principals and to save himself from further loss, the contractor who had furnished funds and equipment had to send in his own organization, take entire charge of the work, purchase additional equipment and complete the contract. The net result of his dealings with this so-called subcontractor was disastrous. "Why all this long story?" you say. Well, Confucius, I think it was, said, "One picture is worth a thousand words."

Selecting Subcontractors—Selecting a subcontractor, particularly when you are furnishing the money and all else, is a serious proposition. The subcontractor ought to furnish, at least, experience and dependability. On his first two jobs the success of the man we have been telling about was at least 90 per cent luck. Everything was with him. No single difficulty came up to bother or try him. When difficulties did occur, he didn't have the experience back of him to meet them and as a result he failed and involved a splendid concern in a trying situation and a big loss.

This man was untried. He had no background. His experience was almost nil. The general contractor, in staking

"If the work to be 'subbed' is of any consequence, the time spent in investigating and selecting the man to do it is well spent."

him on the first contract, was on fairly safe ground. The job was ideal and simple and under the daily observation of the general contractor. But when he financed and equipped the subcontractor on an uncertain, uninvestigated job in a remote country and threw him entirely on his own responsibility, he took a chance which ultimately cost him dearly. The selection of subcontractors is an important matter and often is the deciding factor in the results of a job. Some "subs" may be able to handle competently certain work in certain locations and fail utterly on other work in other locations. If the work to be "subbed" is of any consequence, the time spent in investigating and selecting the man to do it is time well spent, and will repay the general contractor many fold in actual dollars and cents and in freedom from worry about that particular portion of his work.

Responsibility—Unless the work is of a very minor nature the subcontractor should have the same responsibility for the work he does as rests upon the general contractor. This principle should apply if the work is "subbed" more than once. On an irrigation canal in the west a certain section was "subbed" three times. The first two "subs" were made responsible, the first to the general contractor, and the second "sub" to the first. But the second "sub" failed to make the man he "subbed" to responsible. Things went along all right for a while. The digging was good for team work, and the pay was prompt. After a while, though, our third "sub" ran into some tough material that had to be drilled and blasted. There was a price for this class material and if the situation had been prudently handled no loss would have been incurred. Contractor number three arranged with contractor number two to drill and blast the material, proposing to remove it from the cut with his team outfit. Meantime, he had been practically paid up for what work

"Contractors should pay subcontractors as they themselves are paid—on a unit price basis rather than by the hourly or daily rate of pay method."

he had done. After the material was shot he found he couldn't move it with teams, so he just pulled off the job and went his way. He was under no bond, and even most of his retained percentage had been paid him. There was nothing to prevent his "walking off". Contractor number two had to arrange for power equipment to come in and complete the abandoned work, and when everything was all over he was considerably out of pocket, for no other reason than that he had failed to make his "sub" responsible.

It's no great hardship or difficulty to spend the time necessary to investigate certain men for certain work—their responsibility, experience and ability. Of course, there are occasions where it isn't necessary and isn't done. But, in the main, subcontractors should be made responsible. It gives them the oftentimes needed incentive for efficiency and saves the general contractor from various situations adversely affecting the work, brought about because of the fact that the subcontractor was not tied close enough to it.

Careful study frequently indicates that certain portions of a general contract can be more advantageously and profitably handled by responsible subcontractors. In this category are items of small volume for which the general contractor may not at the time be equipped and work of a peculiar nature for which a certain subcontractor is better equipped, both in experience and plant. Good, reliable subcontractors often operate with amazing efficiency and economy. This is due to concentrated effort, with administration and overhead charges reduced to an almost negligible factor. On one project, remote from the sumptuous offices of the contractor, the overhead and administration charges made necessary by these big city offices would have been counted as a handsome return by some contractor camped on the site. Generally, subcontractors are not burdened by any portion of such handicaps before a lick is ever struck. Most of their expenses are efficient dollars, "dollars that go and come back leading a new little dime by the hand."

"Bargains between contractor and subcontractors can be driven too close. There is no tonic, no stimulant so helpful to 'subs' as for them to make some money now and then."

Pay Promptly—Another thing that should be done whenever possible is for general contractors to pay subcontractors as they are paid: as excavation at so much per yard, rather than trucks at so much per day; concrete, if the hauling is contracted, at so much per yard rather than trucks at so much per day; steel at so much per ton, and on through the list of items. On a sluicing job where 10-in. blocks were used for flume bottoms the cost was cut two-thirds (and the men earned more) by changing from payment by the day to so much per block. On a big dragline job most unusual records were made by paying the operators moderate salaries and then so much per yard for all yardage over a certain agreed-upon minimum. This method resulted in highly gratifying results to both the contractor and the machine operators.

The time is probably not far distant when a great proportion of construction work will be done on the unit compensation basis, rather than by the hourly or daily rate of pay method. This system will help increase efficiency, lower costs, increase the earnings of the workers and eliminate much of the dissatisfaction as to rates of pay. It surely starts the day out wrong to see a string of trucks "at so much per day" lined up behind a balky shovel, dragline or mixer, with the drivers hanging around in groups chewing the rag and the owner off on a fishing trip—what has he to worry about? If he was being compensated by the yard or ton, he wouldn't be away fishing, but on the job rustling work for the surplus trucks made available by the greater efficiency of the trucking worked on the per yard basis. Of course, there are exceptions. However, most trucking can be worked out on a per yard basis and it usually pays contractors well to handle it by this method, even if they have to include something in the per yard price to help protect the trucking contractor for a part of the time loss which is sometimes inevitable and for which he is in no way responsible. This is but fair. But if you want to see a truck man really tend to business, cut corners, invent schemes for efficient operation and breathe them into his drivers, just pay him by the yard or ton, as you are paid.

"The subcontractor should have the same responsibility for the work he does as rests upon the general contractor."

Interference — General contractors should use great care in so ordering their "subbed" work that there will be no conflict between them and their subcontractors or between different subcontractors. On a large job on which sequence of operation was a major factor in the efficient carrying out of the contract, the general contractor "subbed" the dredge excavation, the major item of the contract, amounting to several million yards. The concrete structures, which had to be done ahead of the excavation, he elected to do himself. He failed, however, to keep out of the dredging contractor's way—this contractor was a most efficient operator—and as a result all sorts of complications, charges and counter charges, and eventually suits, entered in. Had this general contractor done his part all of the above would have been avoided and the job would have progressed smoothly and amicably and been completed in a manner satisfactory to all concerned.

It must be said that too often dissatisfaction between general and subcontractors is brought about by too close bargaining. It rarely occurs that when a general contractor holds a "sub" down to the very last cent things go along as smoothly as they should. Bargains can be too close. A peerless contractor of the West, a maker of construction men, often said, in all earnestness: "There is no tonic, no stimulant so helpful to your 'subs' as for them to make some money now and then." If you squeeze 'em too tight by and by you yourself get squeezed, and oftentimes in most unexpected ways—the age-old law of compensation seems to look out for this.

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NEXT MONTH. In the ninth installment of this series of articles Mr. Locher will discuss "Progress Schedules."

Peat Marsh Filled by Displacement With

WATER JETS

WATER jets to aid displacement of compacted organic matter by surcharged fill have proved successful in a number of experiments by the Michigan State Highway Department in filling peat marshes. An outstanding test of this method was the filling project across the Chandler Marsh, north of Lansing, on U. S. 27. More than half of this project, 6,590 ft. in length, was filled by the jetting method. Jets used in advance of the fill saturated and softened the peat, thus facilitating displacement by the surcharged load of sand and gravel.

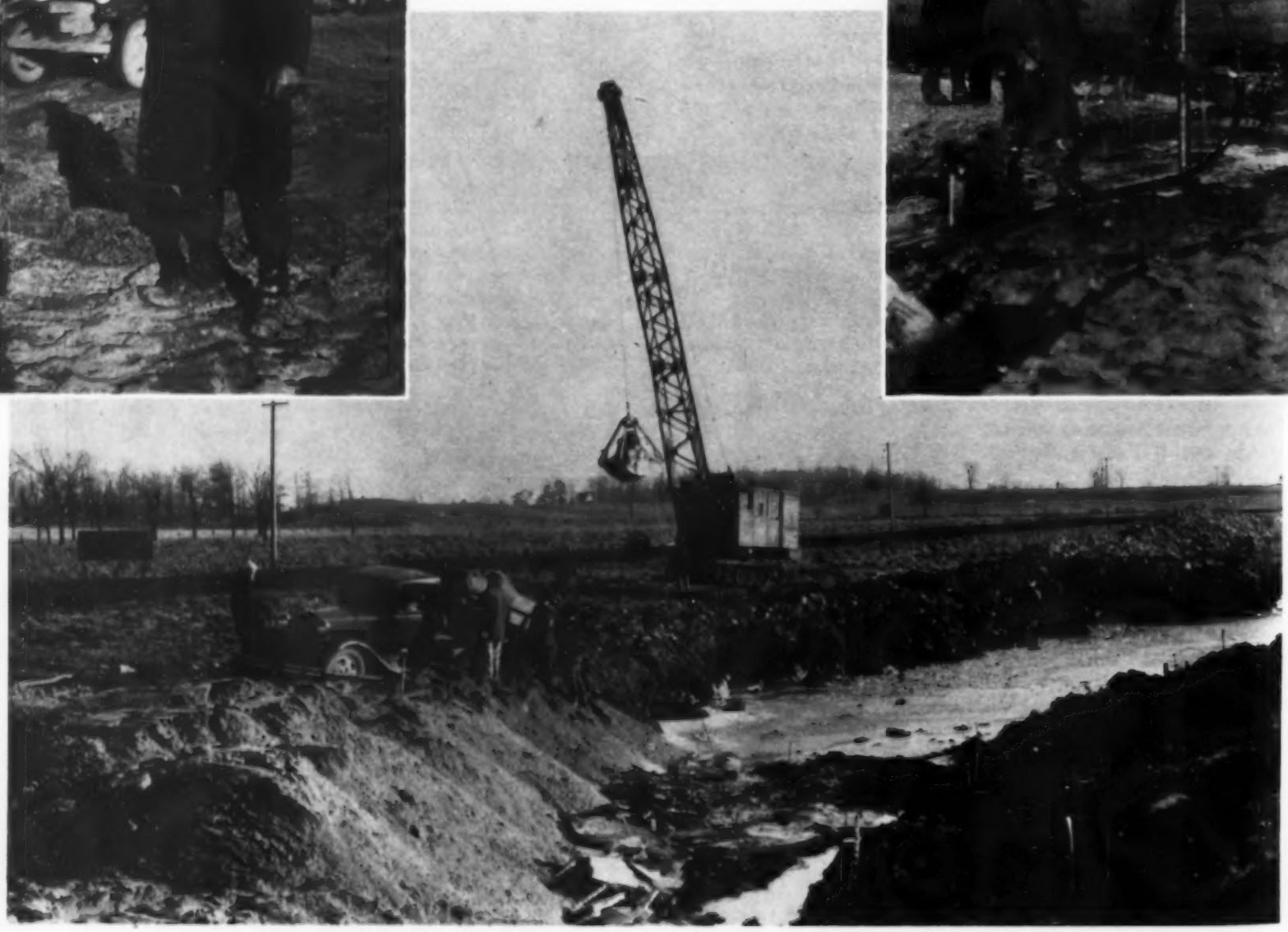
Other Filling Methods—An alternative method of the Michigan State Highway Department, using explosives to blast the peat layer and allow settlement of the superimposed fill, was described in *Construction Methods,* July, 1930, pp. 62-64. This article stated that blasting was used only for peat deposits greater than 8 ft. in depth. For shallow deposits, excavation of the peat to solid foundation has always been preferred.

Displacement with the aid of jetting was first used on a filling project where the presence of a bridge structure in the middle of a marsh forbade blasting. The engineers conceived the idea of softening the compacted organic matter by forcing water through pipes into the peat, thus accelerating lateral displacement. Following successful application of the method on this project, jetting was employed at a number of other locations, and encouraging results were obtained in most cases. Experience showed that jetting was more successful when used just in advance of filling than when used directly under the surcharged load of dry material.

Chandler Marsh Fill—The original fill across the Chandler Marsh was completed in 1921. No attempt was made to sink this fill to solid bottom prior to

H. BLOOM, superintendent, directs excavating and filling operations for A. Guthrie & Co.

WASH BORINGS *(right)* through jetted fill indicate that peat has been displaced to sound clay or hard sand bottom in practically all cases.



EXCAVATING AND FILLING to clay layer are specified where depth of peat does not exceed 10 ft. Draglines and clamshell crane dig center trench first to be filled ahead of side trenches. This procedure avoids trapping soft material in fill.

paving with an 18-ft. concrete road in 1923. As a result progressive settlement took place. By 1928, actual settlement of the pavement ranged from 0.02 ft. to 3.02 ft. The present program provides for ultimate widening of the pavement to 40 ft., but even if this widening had not been contemplated, it would have been necessary to raise the old highway back to grade.

Soundings were taken at 40 points along the roadway to determine the thickness and character of the fill, peat and clay beneath the pavement. A blue-clay layer of unusual thickness lay between the peat deposit and hard sand bottom. The depth to the bottom of the peat deposit varied up to a maximum of 35 ft. and averaged about 14 ft. Maximum depth from grade to solid sand bottom was about 45 ft.

It was believed that the blue clay stratum would make a satisfactory foundation for the fill. The engineers determined to excavate to the clay wherever the depth did not exceed 10 ft., and to displace the peat by jetting where the depth exceeded this distance. To provide for the 40 ft. pavement, a 56-ft. width of fill was necessary. The estimated quantities of material required for the fill were 203,574 yd. for the displacement section, 112,389 yd. for the excavated portion, and 167,496 yd. for the remainder of the project, making a total of 483,459 yd. of borrow. The contract was awarded to A. Guthrie & Co., Inc., of St. Paul, Minn. By working 24 hr. a day from the start on September 15, 1931, this firm completed the fill before the specified date of July 1, 1932.

General Displacement Procedure—Five sections of the project were filled by the displacement method. The fill advanced behind the jetting crew in spear-head fashion, the center being built up first to assure lateral displacement of the underlying peat and to minimize the danger of trapping organic material underneath the central portion of the fill.

As the first step in the displacement process, the contractor broke up the old 18-ft. pavement and excavated 25-ft. trenches to a depth of approximately 6 ft. on both sides of the center strip. These trenches facilitated displacement of the peat by the surcharged fill.

Jetting Procedure—State Highway Department forces carried on the jetting operations. As many as 30 1¼-in. pipes equipped with jet points having four 3/16-in. discharge holes were used at one time in saturating the peat. As shown by the accompanying sketch, these jets were installed as follows:

One row was placed along the center line of the old fill, and one row along each side of the old fill, the jets in these rows being spaced 20 ft. apart longitudinally. Jets in two other rows installed along the outside of the displacement trenches were placed about 30 ft. apart. As the fill advanced, the center jets were pulled and moved ahead or to the outside of the displacement ditches. The jets on the outside were generally left in place until the advance of the fill required their use ahead.

A three-stage 5-in. Union centrifugal pump driven by a 90-hp. Buda gasoline motor supplied 500 g.p.m. to the jets at a pressure of about 50 lb. per square inch. A header pipe from the pump was laid along the outside bank of each trench, and manifolds for jets were T-connected to these header pipes at regular intervals. Water was delivered from the manifold to each jet pipe through a 1¼-in. rubber hose of sufficient length to reach the jet.

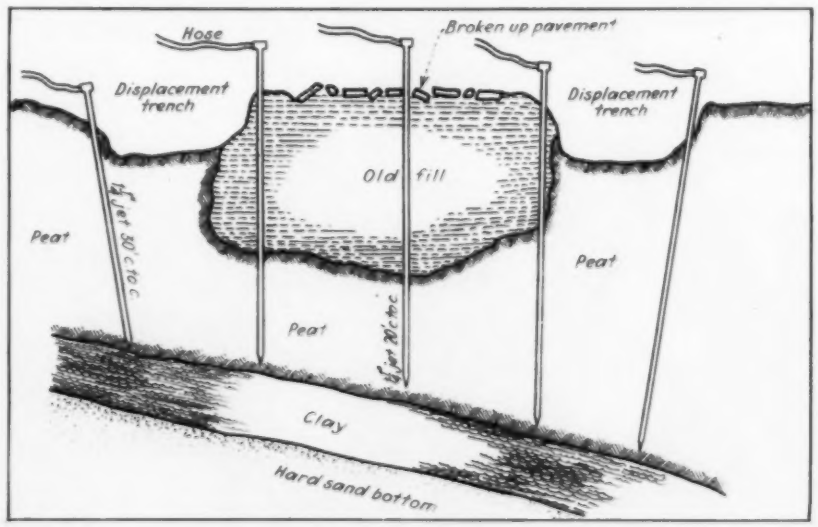
Results of Jetting—As already stated, the engineers relied upon the blue clay stratum to provide a satisfactory foundation. On the jetted sections, however, it was found that the jets saturated the clay, in some instances causing the clay as well as the peat to be displaced by the surcharged fill. This result, although in no sense undesirable, greatly increased the amount of fill material needed for the jetted sections of the marsh.

It was noted on this project, as on others previously jetted, that the peat heaved up in great ridges, 6 to 10 ft. high, on both sides of the fill. Wide cracks opened in the surface of the peat, which moved a considerable distance laterally. Wash borings made at frequent intervals through the completed fill demonstrated that, with the exception of a few instances, the peat had been entirely displaced by the downward moving fill.

Excavating Methods—Where the depth to blue clay did not exceed 10 ft., the contractor excavated to this stratum and placed the fill on the clay foundation. This process was carried out in three passes of the excavating machines, a Bucyrus 2-yd. dragline, a Bucyrus 1½-yd. dragline and a 1-yd. Northwest clamshell crane. A center trench was excavated and filled first and two side trenches subsequently. By excavating and filling in this way, the contractor provided for displacement from the center outward and reduced the danger of trapping any soft material in the fill.

Administration—Filling of the Chandler Marsh was under the general direction of Grover C. Dillman, state highway commissioner; Clifford E. Foster, chief engineer, and W. W. Lavers, construction engineer of the State Highway Department. Under H. G. Oakes, division engineer, field operations were directed by R. R. Havens, resident construction engineer, and C. J. Noonan, project engineer. In addition, the Research Division of the department maintained a close working contact with the operations at all times, assisted in keeping records and acted in an advisory capacity. H. Bloom, superintendent, was in charge of the work for A. Guthrie & Co., Inc. George Burley directed jetting operations for the State Highway Department.

JET PIPES along two sides of each displacement trench and along center line of old pavement (which lies to right of water-filled trench in foreground) soften peat so that it can be displaced by surcharged load of dry fill advancing in spearhead fashion in background.



CROSS-SECTION DIAGRAM of jetting operation, indicating relative positions of old fill, peat, clay, and sand bottom. Trenches to facilitate displacement of peat are excavated along both edges of old fill, and jet pipes are installed in five longitudinal rows.

Getting Down to

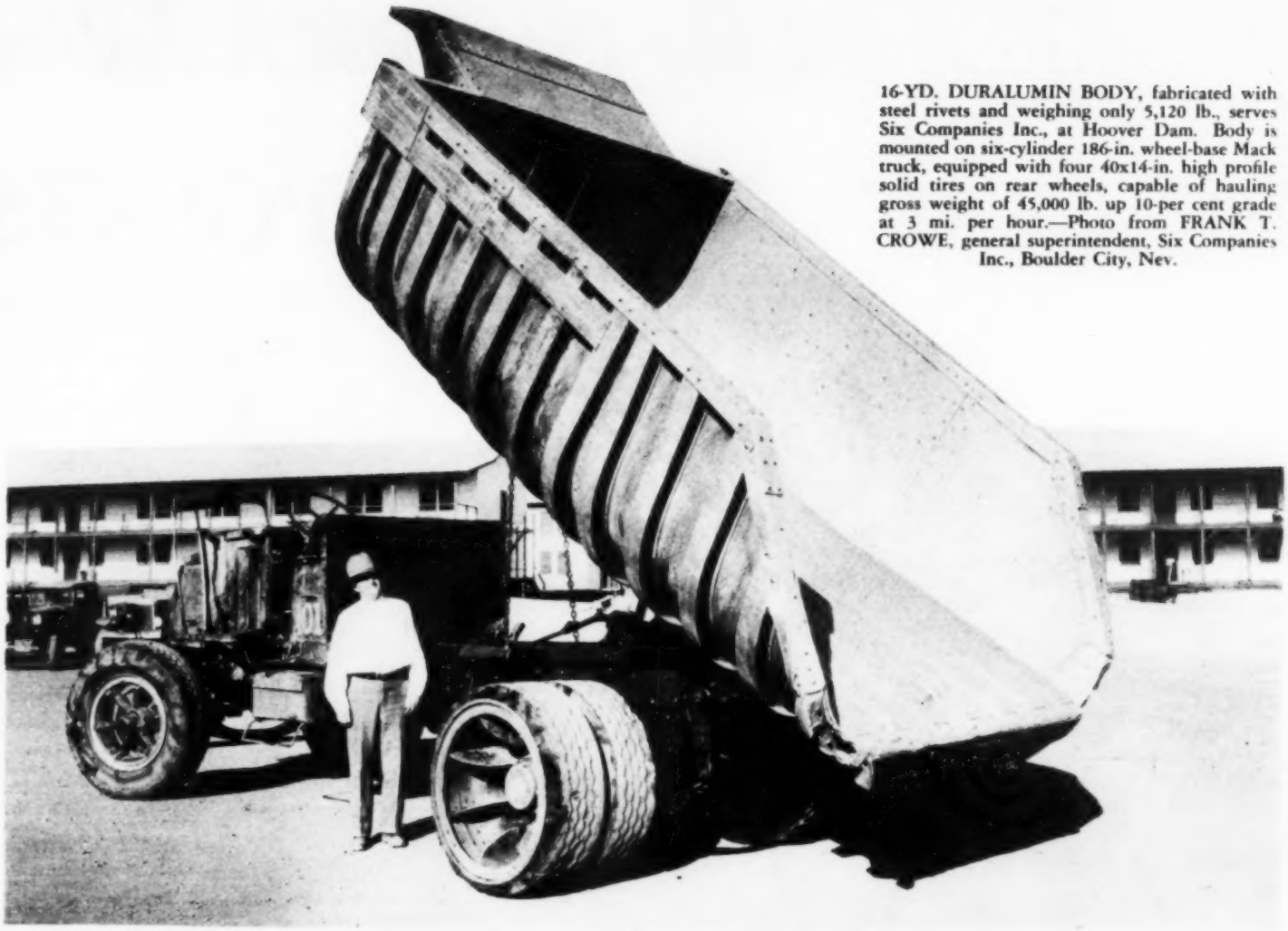
DETAILS

[Close-up Shots of Job Methods and Equipment]

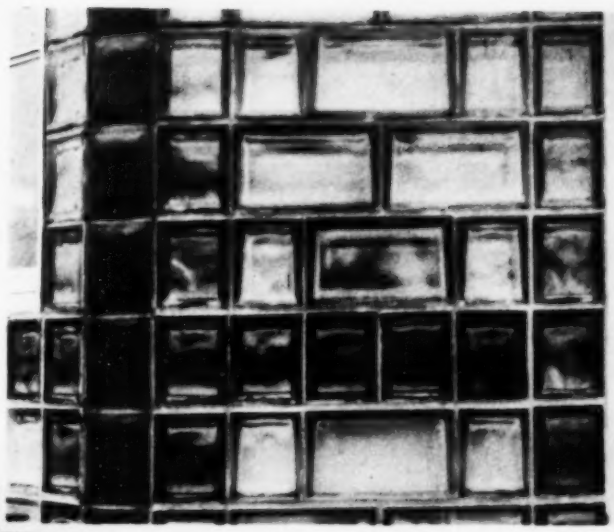
STEEL CURB AND RAILING UNIT, shop-fabricated for elevated viaduct approach to Holland tunnel, erected by New Jersey State Highway Commission, as described elsewhere in this issue, is designed to stop vehicles from plunging off side of elevated highway.

175-FT. ALUMINUM-STEEL BOOM on Bucyrus-Erie dragline handles 7-yd. bucket for Arundel Corp., of Baltimore, on levee building contract at New Roads, La.

CHANNEL CHANGE *(below)* in Grand River at Painesville, Ohio, involving removal of 500,000 yd. of earth, is being made for Diamond Alkali Co. by H. E. Culbertson Co., of Cleveland, with Link-Belt mobile, track-mounted belt conveyor, 2-yd. dragline and one other excavator. Dragline delivers spoil to traveling hopper on conveyor bridge. Swinging boom at end of conveyor system builds dike 250 ft. high and 6,500 ft. long to provide additional storage area for refuse from alkali plant.

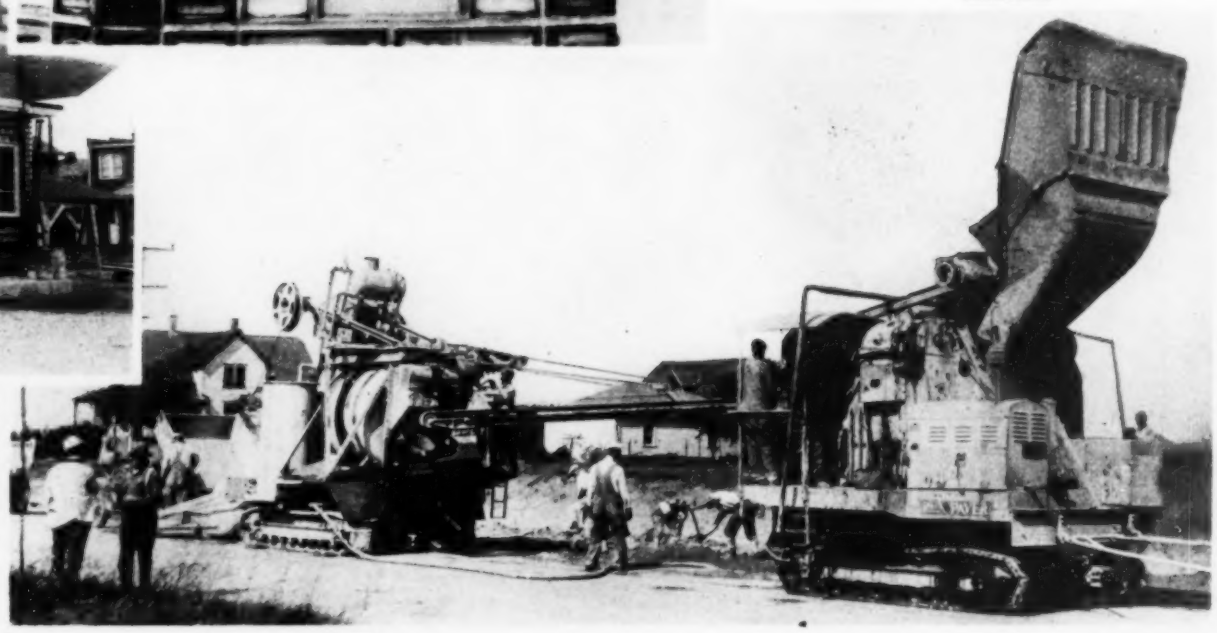


16-YD. DURALUMIN BODY, fabricated with steel rivets and weighing only 5,120 lb., serves Six Companies Inc., at Hoover Dam. Body is mounted on six-cylinder 186-in. wheel-base Mack truck, equipped with four 40x14-in. high profile solid tires on rear wheels, capable of hauling gross weight of 45,000 lb. up 10-per cent grade at 3 mi. per hour.—Photo from FRANK T. CROWE, general superintendent, Six Companies Inc., Boulder City, Nev.



GLASS BRICKS developed by Owens-Illinois Glass Co., of Toledo, Ohio, form enclosing walls of garage and office at Columbus, Ohio, service station erected by Branch Construction Co. for Ohio Oil Co. Brick are hollow, being cast first with one end open. This end later is hermetically sealed under heat with glass square. Some bricks are painted red and then baked to give contrasting color for trim *(above, right)*. Four sizes of brick are used in this structure, laid up with cement-sand mortar.

TANDEM PAVERS FACING EACH OTHER *(below)* and moving in same direction on one lane of existing pavement increase concrete production on widening job of I. D. Lane Co., Morton Grove, Ill. Two Rex pavers thus are combined for maximum production in tandem operation despite difference in drum capacities. Setup is served by one batching plant, one pumping system, one spreading crew, one finishing crew and one superintendent.



Penetration of Long Pipe Piles Aided by

CAST-STEEL POINTS

DIFFICULT soil conditions along the river front on the west side of Manhattan offered marked resistance to the driving of steel-pipe piles to rock at depths of 80 to 186 ft. for a section of the West Side Elevated Public Highway between 22nd and 38th Sts. recently completed for the Borough of Manhattan by the Poirier & McLane Corp., of New York City. Cast-steel driving points and internal sleeves supplied by the Otis Elevator Co. facilitated the driving of piles and kept the pipes dry for placing concrete.

This part of Manhattan consists of made ground produced by pushing the bulkhead line farther into the river and by filling on top of the original silt. The foundations piles encountered numerous buried obstructions such as rock-filled timber cribs and sunken barges. Experience on previously constructed sections of the highway had shown that steel-pipe piles were the only practicable foundation for these conditions.

A total of 971 steel-pipe piles aggregating 119,000 lin. ft. in length were driven with Vulcan single-acting 5,000 lb. hammers. The pipe was 18-in. O. D. seamless tubing with a ½-in. wall. Most of the pipe was in 40-ft. sections supplied by the National Tube Co., although some 30-ft. to 50-ft. lengths of other makes were used. Both the cast-steel driving points, weighing about 140 lb. each, and the internal sleeves were made 1/16 in. larger than the inside diameter of the pipe. These units were tapered at the open ends to start the pipes, which were driven on under the hammer to make a watertight fit.

LONG GIRDER *(below)* for elevated highway span is raised to position from two trailer trucks by pair of crawler cranes.

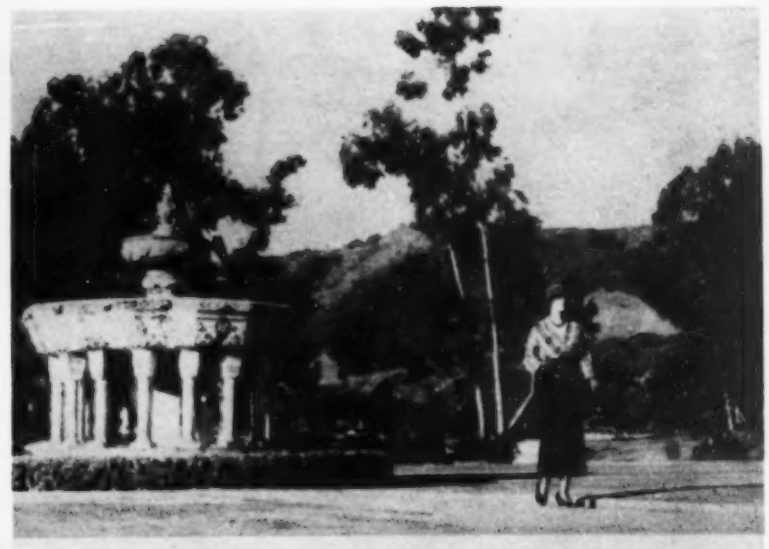
CAST-STEEL DRIVING POINTS and internal sleeves *(left)* are slightly larger than interior diameter of pipe, and must be driven on to make tight fit.

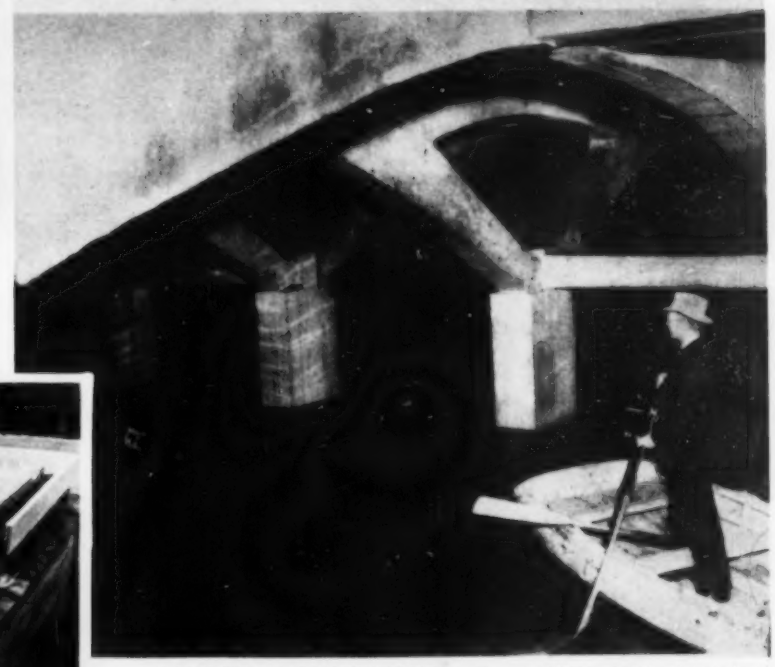
FIRST SECTION *(below)* of steel-pipe pile with driving point attached is raised into leads and placed under hammer of pile-driver.

JOB ODDITIES

A Monthly Page of Unusual Features of Construction

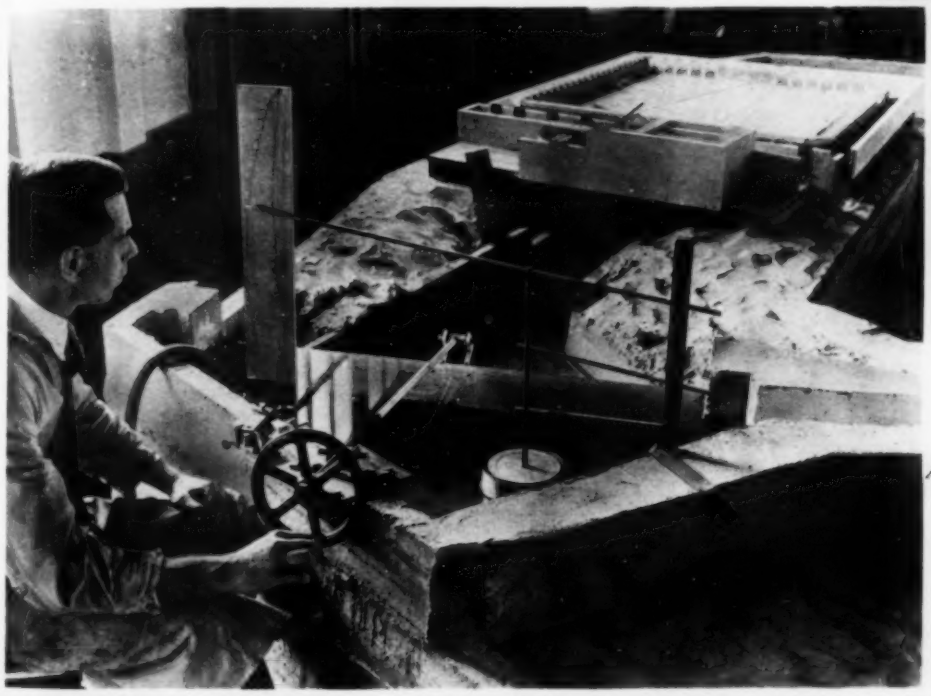
DIAMOND-SHAPED SKEW BASCULE carries New Jersey 40-ft. roadway across canal at skew angle of 66 deg. In plan, bridge measures 45 ft. on short diagonal and 207 ft. on long diagonal. Main trunnion and counterweights are located on extension of one of short sides, about which span revolves. Construction of skew bascule eliminated sharp kink in U.S. 1, main Philadelphia-New York highway, 6 mi. north of Trenton.





PARK ROOF ON RESERVOIR at Beverly Hills, Calif., is supported by reinforced concrete arches of unusual design, resting on columns connected by struts. Because water-supply reservoir occupied beautiful site, city decided to utilize it as park by covering with concrete, spreading 2 ft. of soil for shrubbery and trees, and installing fountain.

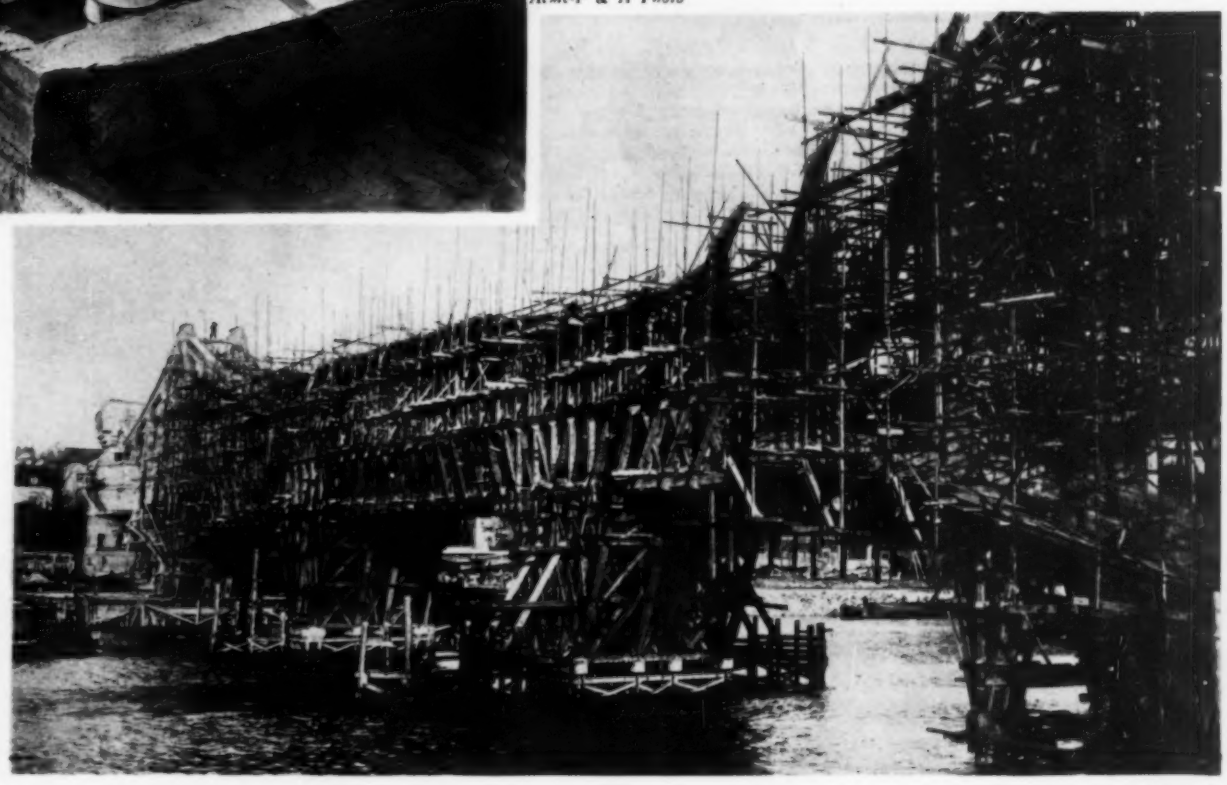
International Photo



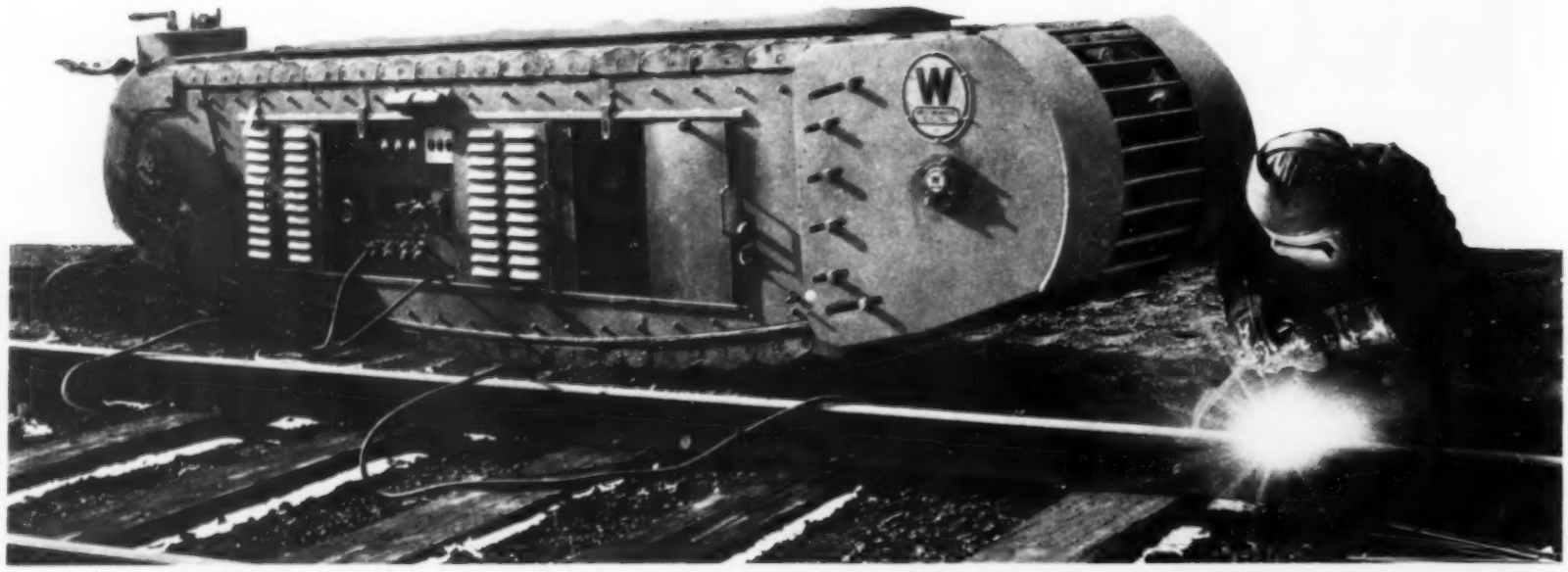
MECHANICALLY CONTROLLED TIDES are a feature of this model of Buzzards Bay end of Cape Cod Canal, demonstrated by Prof. K. C. Reynolds in hydraulics laboratory of Massachusetts Institute of Technology. By turning hand crank, operator moves hinged board which causes water level to rise or fall in simulation of tidal action.

Keystone Photo

Acme-P & A Photo



BRIDGE TO CARRY ELECTRIC CABLES *(right)* and two sidewalks for pedestrians is constructed of reinforced concrete across River Seine at Paris, France. Elaborate timber falsework towers and trusses support structure, which has total length of about 720 ft., during construction.



TRACTOR WELDER for railroad track maintenance provides mobile power supply unit which travels on shoulder and eliminates interference with traffic and signal operations. Buda six-cylinder 65-hp. gasoline motor furnishes ample power for simultaneous operation of variable-voltage welding generator (supplying current to one operator) and auxiliary d.c. generator on same shaft, delivering power for grinder, slotter, other tools or lights. Two propulsion motors take power from welding generator, speed being regulated by rheostat control of excitation current from auxiliary generator. Overall width, 30 in.; height, 36 in. to top of upper tread. Hand switches provide for independent operation of propulsion motors in forward and reverse. Tractor climbs 35-deg. incline and is stable in operation on 45-deg. side slope. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

NEW EQUIPMENT

ON THE JOB

DRAGLINE ROCKER BUCKET incorporates hood which rocks bucket backward and drops it on its teeth, doing away with time loss in lifting bucket on its teeth by forward pull on load line. Design almost eliminates forward projecting sides with attendant bending, thus reducing need for reinforcement and decreasing weight. When lowered, bucket strikes on forward hood and rolls into digging position with entire weight on teeth. Adjustable hitch plates increase digging effectiveness in deep pits. Available in all sizes and for all classes of work. Page Engineering Co., Chicago, Ill.

PORTABLE ELECTRIC POWER GENERATOR, weighing 35 lb. and measuring 10x12x14 in. over all, develops 350 watts at 350 cycles and operates any universal or d.c. 110-v. motor up to ¼ hp. Powers 300 to 350-cycle field tools direct; universal equipment and appliances by hook-up with rectifier furnished with unit. Gasoline engine and generator form self-contained unit. Runs 3 to 5 hr. on 1 gal. of fuel. Started by winding cord around exposed end of flywheel and giving sharp jerk. Collapsible handle for carrying. Heintz & Kaufman, Ltd., 311 California St., San Francisco, Calif.

ZONE MARKING PAINT *(left)* on Cleveland high-level bridge shows clean-cut edge, solid covering, and perfect visibility after 17 days' use. Romark is said to be first traffic paint to stand up for 2 weeks on this bridge, carrying 70,000 vehicles daily. Applied in this case ⅛ in. thick at 35 deg. F. and allowed to dry 2 hr. Glidden Co., Cleveland, Ohio.

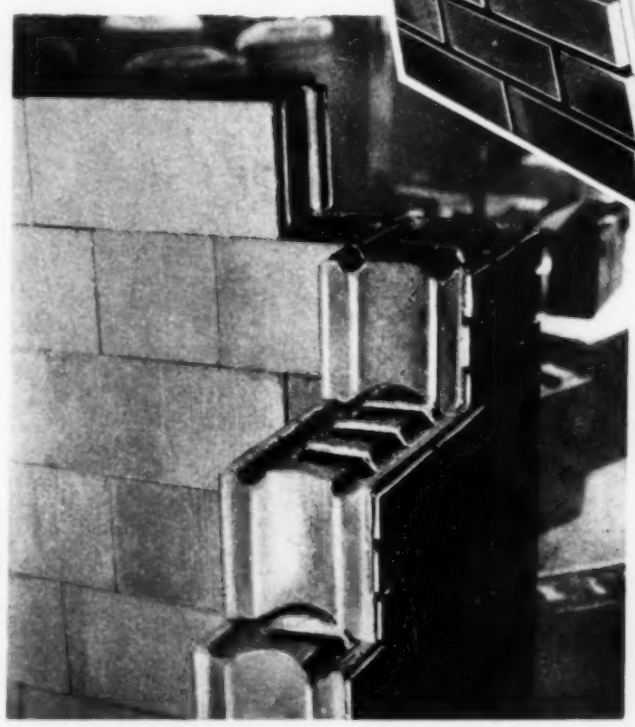
If You Want Further Information—

Within the space limit of these pages it is impossible to present complete information about the products illustrated.

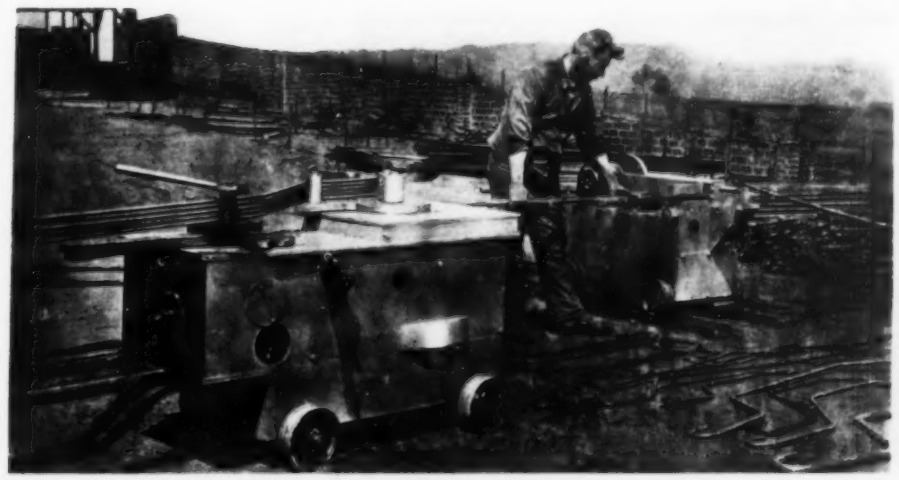
The manufacturers, however, will be glad to supply further details if you will write to them.

HOLLOW CONCRETE BLOCK *(below)* incorporating genuine brick face mechanically interlocked with cast concrete unit provides masonry wall offering economy and insulation of hollow wall with further advantages of pleasing exterior surface and tongue and groove construction which eliminates uneven and unsightly joints. Façades of burnt clay brick, glass brick, limestone, terra cotta and other materials can be cast into this type of block, which is manufactured on standard concrete block machines with only minor changes in equipment. Horizontal and vertical air spaces. Mortar seal is positive and hidden; horizontal air space furnishes displacement area for excess mortar. Smooth inner wall surface for plaster or paint. Exclusive licenses being granted for manufacture and sale of block. National Façade Corp., 730 Park Bldg., Pittsburgh, Pa.

HIGHWAY PATROL GRADER equipped with 42-hp. gasoline motor of removable-sleeve type is constructed for normal operation at standard third speed of 5 mi. per hour. Rear axle without differential, rigidly connecting driving wheels on both sides, gives positive traction at all times. All adjustments of blade and scarifier are made by power taken off front end of tractor, where power is continuously available. Every movement between moldboard and main frame is carried on bearings which can be adjusted to take up wear. Bolted construction throughout. Distance of 95 in. from front axle to moldboard reduces vibration and gives blade pressure of 7,240 lb. Gasoline tank holds 52 gal. Allis-Chalmers Mfg. Co., Milwaukee, Wis.



DIGS, HAULS, DUMPS AND SPREADS. Train of three or four Insley-Hercules scoops *(below)* of 1- or 2-yd. capacity operated by one tractor. Scoop is round-edged bowl suspended on springs connected by pair of bars to axle passing through hubs of wheels. Operator controls depth of cut to fraction of inch with lever and hand line connected to external expanding band clutch incorporated as part of axle. Engagement of clutch turns axle forward lowering scoop into digging position and lengthening tension springs. When digging is completed, release of clutch allows power of springs to lift bowl clear of ground into traveling position. Dumping is done by repeating engagement of clutch, at same time releasing latch on drawbar. Scoops connected by swivel hitches. Operator's platform mounted on first scoop.—Insley Mfg. Co., Indianapolis, Ind.



AUTOMATIC BENDING MACHINE bends one or more bars at a time and makes two, three or four bendings simultaneously with aid of special equipment installed without removing bending plate. Machinery entirely inclosed. Made in four sizes. Size 32, smallest machine, weighs 1,885 lb., equipped with 1½-hp. electric motor, makes single bends in one 1¼-in. bar or ten ½-in. bars, round or square. Size 60, largest machine, weighs 3,500 lb. with 4-hp. motor, makes single bend in one 2⅜-in. bar, or four 1⅛- to 1¼-in. bars. Special equipment makes multiple bends, spirals, stirrups, etc. G.D.S. Shearing & Punching Machine Co., 101 Walker St., New York, N. Y.

Present and Accounted For —

A Page of Personalities

HEAD FEDERAL WORK-RELIEF PROGRAM. Robert Fechner *(left)* is director of Emergency Conservation Program by which federal government is providing work for 250,000 unemployed men who will be engaged largely in construction and conservation activities on public preserves. R. Y. Stuart, *(right)* chief of U. S. Forest Service, will indicate type of work to be performed by men in camps in national forests and will cooperate with state foresters in outlining work to be done in state forests.

Harris & Ewing Photo

ROAD BUILDERS' PRESIDENT. H. C. Whitehurst, elected president of American Road Builders' Association at Detroit meeting in January, takes office as chief executive of organization at regular annual meeting in Washington, D. C., May 11. Captain Whitehurst is director of highways of District of Columbia. He succeeds as A. R. B. A. president T. H. Cutler, chief engineer of Missouri State Highway Department, whose term expires with May meeting.

HIGHWAY OFFICIALS' EXECUTIVE. Lucius D. Barrows *(below)*, chief engineer of Maine State Highway Department, is newly elected president of Association of Highway Officials of North Atlantic States After service with Bureau of Public Roads, Mr. Barrows entered Maine highway department in 1910 and assumed office of chief engineer in 1928.

BADGE OF MERIT. C. H. Thomson *(below)*, construction foreman of International General Electric Co., was decorated by Soviet government with Order of Red Banner and was awarded citation and honorarium by Charles A. Coffin Foundation for distinguished services in installing five large waterwheel generators at Dneprostroy hydro-electric project.

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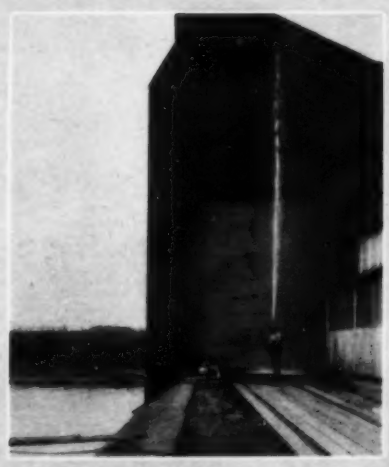

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At right: Assembling "Metaforms" —Steel form units—for a reinforced concrete swimming tank in basement of gymnasium. Note three inside form sections for girders supporting sloping bottom of tank. Girder forms were poured to specified slope. Reinforcing steel tied in position to steel spreader ties in forms. Simplicity of assembling speeds form building with "Metaforms"

Below: Showing offset for wall pilaster, horizontal and vertical liners secured with eccentric clamps and steel spreader ties inside of forms. Liners used on only one side of forms

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Below: Metaforms for straight wall construction as used on above jobs

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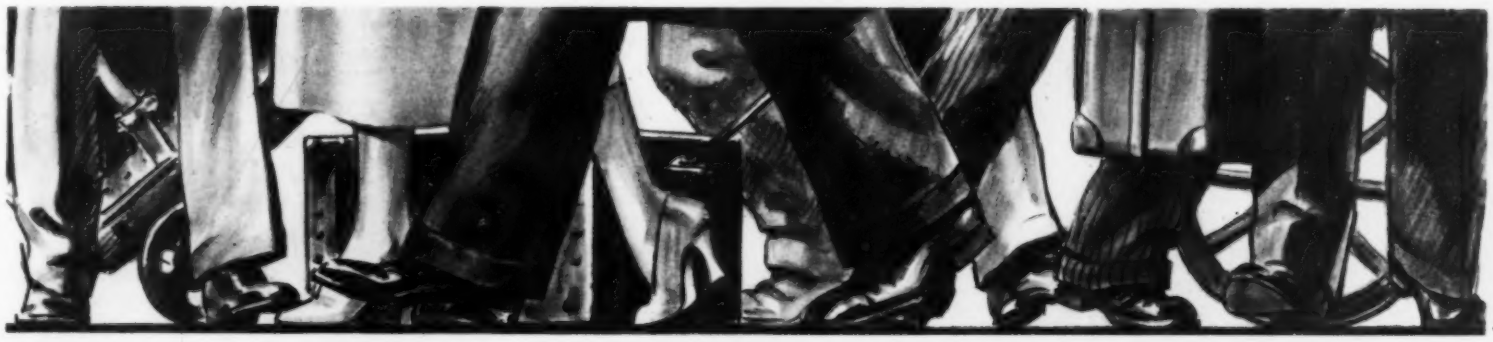

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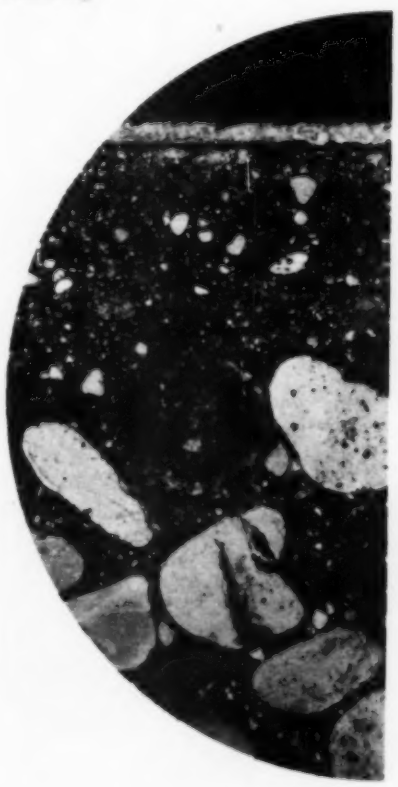
WRONG

See that white line? It's a "dust on" type of finish, too soft, too porous to stand the gaff of wear. Picture shows a cross-section cut from a slab that crazed in ten days after finishing.



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RIGHT

See the coarse material in the surface of this section? This is the kind of concrete floor that gives lasting satisfaction. Yet it is simple to lay and ordinarily costs no more than the old-fashioned method.

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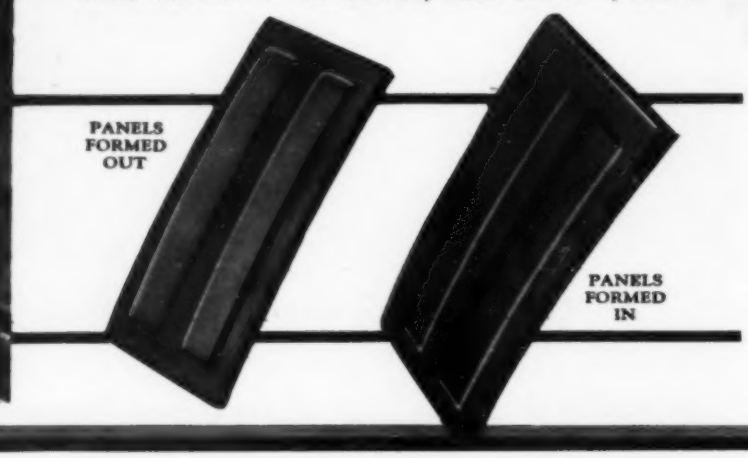

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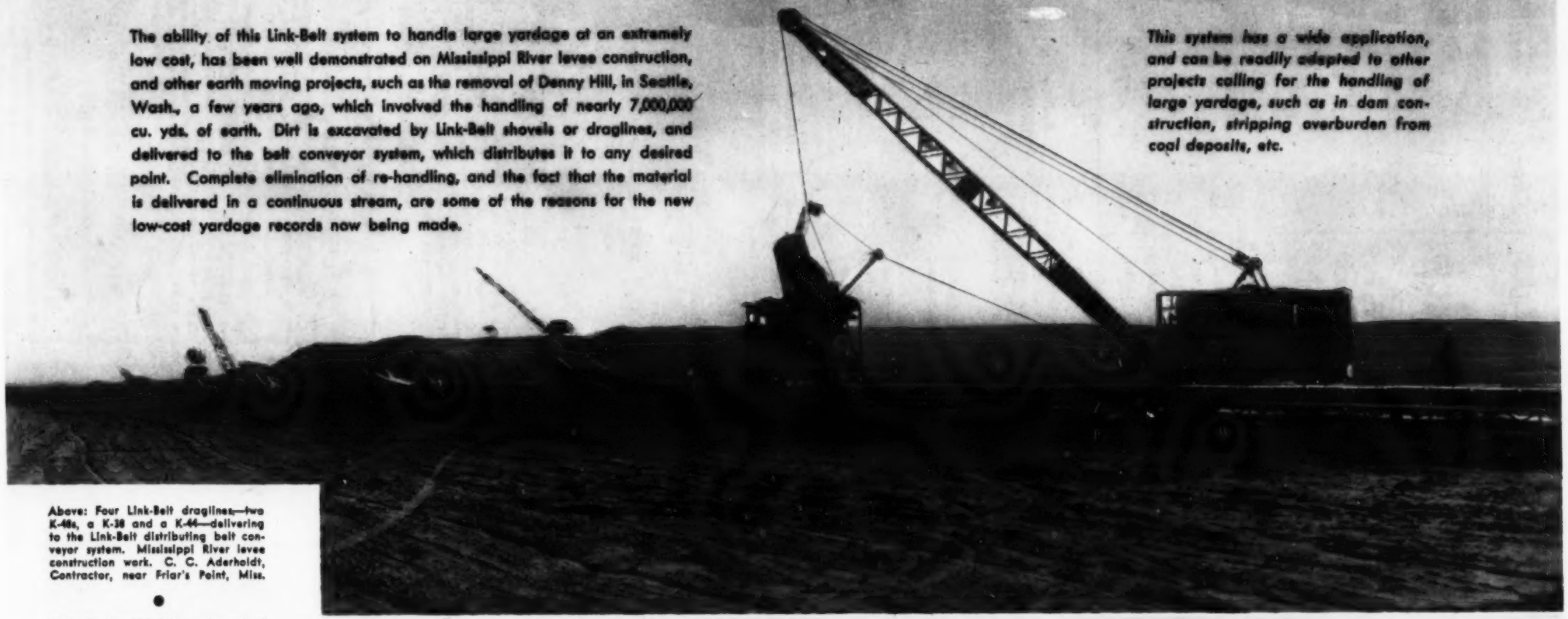

Above: Four Link-Belt draglines—two K-46s, a K-38 and a K-44—delivering to the Link-Belt distributing belt conveyor system. Mississippi River levee construction work. C. C. Aderholdt, Contractor, near Friar's Point, Miss.

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Part of the Link-Belt equipment of H. E. Culbertson Co., of Cleveland, engaged in changing the channel of the Grand River. Dirt from the new channel is thrown up as a dike to provide additional spoil storage space for refuse from Diamond Alkali Company's Plant, Fairport, Ohio.

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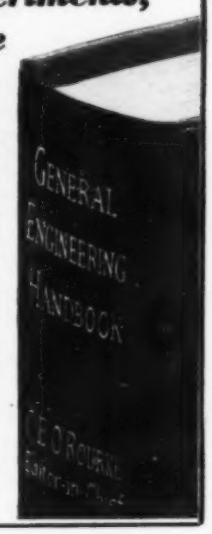

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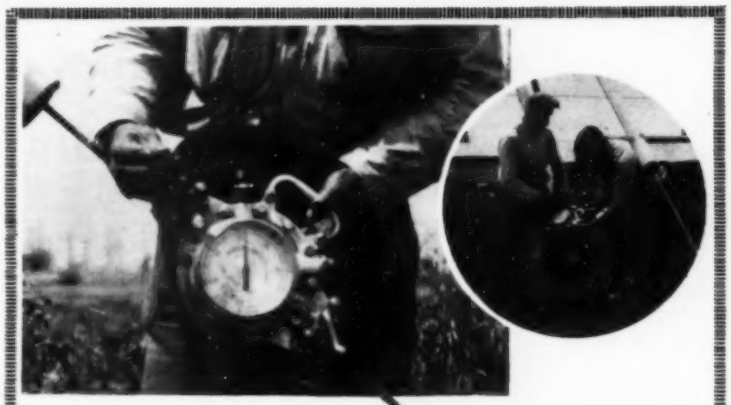

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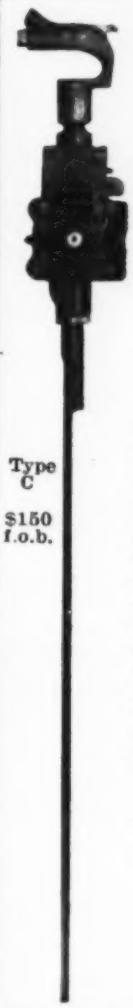

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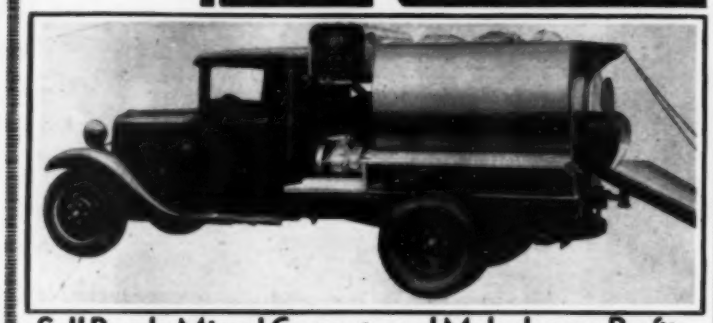

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Classified Business Opportunities for Contractors Manufacturers—Distributors in the

McGRAW-HILL CONSTRUCTION DAILY

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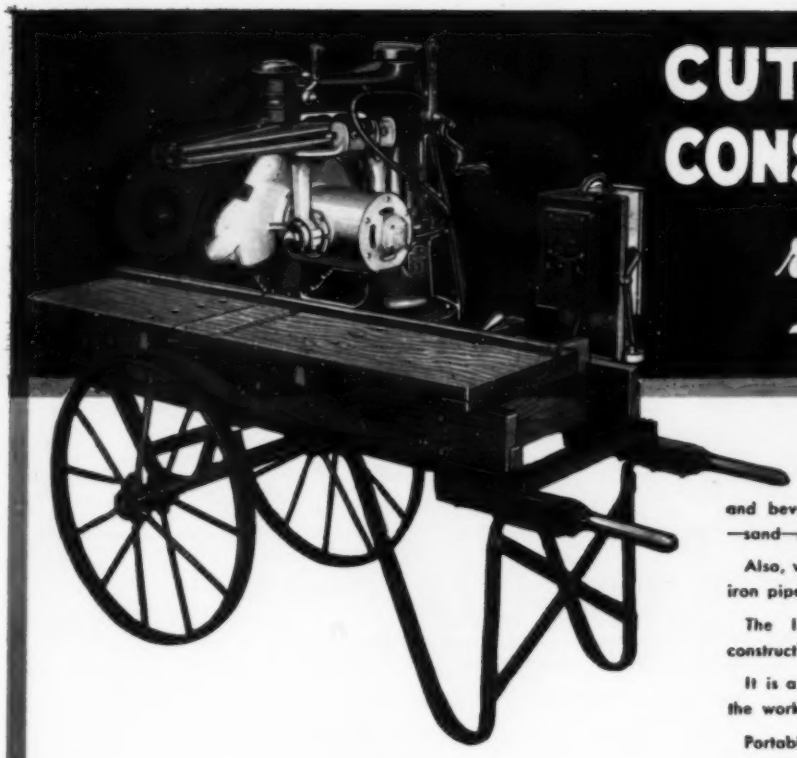


CUT AND SHAPE ANY CONSTRUCTION MATERIAL

rapidly with Multiplex -new cost saver

New—speedy—versatile—multiplex is a machine that will save you many times its cost in a year's time.

It will do anything to wood except plane it—will cross cut—rip—miter and bevel (simple and compound)—mortise—tenon—shape—rabbet—groove—match—sand—make panels—etc etc.

Also, with easy changes of tools it will cut steel, aluminum, brass, slate, brick, tile, iron pipe, bakelite, fibre, formica, wall board of all kinds.

The limits of its operation are remote and seldom to be found on a construction job.

It is a production tool. Set up for any sort of job is easily and quickly made, and the work goes rapidly after set up.

Portable—built of aluminum—steel and malleable iron for lightness and strength.

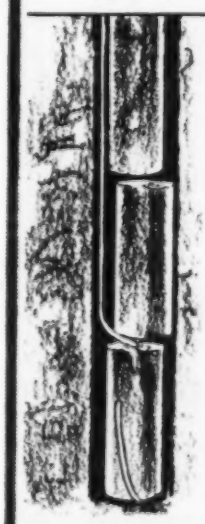
This is a machine you need—let it begin earning money for you—now.

CROSS CUT — RIP — BEVEL MITER — COMPOUND BEVEL — COMPOUND MITER
DADO — TENON — SHAPER — PLOUGH — WOOD — BRICK
TILE — METAL — SLATE — COMPOSITION

RED STAR PRODUCTS CORPORATION - CLEVELAND, OHIO
POSTAL STATION D

For Better Fragmentation

CORDEAU BICKFORD
DETONATING FUSE



Gets more work from your explosives. Decreases loading time, lowers hazard -- and results in better fragmentation. Cordeau-Bickford has made the giant blast possible -- and practicable. Send for a free copy of the Cordeau Book. You'll find it interesting.

THE ENSIGN-BICKFORD COMPANY
SIMSBURY -- CONNECTICUT

GIANTGRIPT WATER RATIO HAND FLOATS

Designed for the dry and hard-to-finish mixes met in water ratio concretes, GiantgripT Water Ratio HandFloats have the correct'heft' for the delicate final finishing to remove surface irregularities and stone-pockets.

Accurately cut from clear knot-free cypress, the floats are fitted with hard wood end-cleats dadoed into place to prevent end warp.

Steel tubing stiffener provides handle attachment and thru steel adjusting studs permits easy adjustment of float to maintain straightness. Constant planing is thus eliminated.

Used with the famous GiantgripT Handle and drop-forged connector which provides a wiggle-proof handle attachment these floats are available in every length and width required by State Highway Department specifications.

Send for Catalog describing entire GiantgripT Line of Hand Paving Tools.

L and M Manufacturing Company
10298 Berea Road—Cleveland, Ohio

Makers of the famous **GIANTGRIPT** *Straightedge*

OUT of present conditions will emerge the new materials, new machines and new methods that will provide the foundation for our next period of prosperity. These improvements are even now coming to fruition in the laboratories, engineering departments and shops of the country's progressive manufacturers. Engineers, constructors and executives owe it to themselves to keep in close touch with current developments. The advertising pages of *Construction Methods* provide an effective means of contact—take advantage of the information they offer.

ALPHABETICAL INDEX TO ADVERTISERS

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SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

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Positions Wanted, 5 cents a word, minimum $1.00 an insertion, payable in advance. *(See ¶ on Box Numbers.)*

Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.

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4 to 7 inches ..... 5.50 an inch

Other spaces and contract rates on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL 10 A. M. THE 27TH OF THE MONTH FOR THE ISSUE OUT THE FOLLOWING MONTH

WEMLINGER STEEL SHEET PILING
SOLD—RENTED—BOUGHT

NEW YORK 500 Fifth Ave. | CHICAGO 228 No. La Salle St. | PHILADELPHIA 1015 Chestnut St. | RICHMOND 1708-1722 Lewis St. | TAMPA 206 Madison St. | NEW ORLEANS 1105 Maritime Bldg. | HOUSTON 117 Eastwood St. | LOS ANGELES 2044 Santa Fe Ave.

● **PUBLIC AUCTION SALE, MAY 18, 1933** *at Bound Brook, N. J., of equipment formerly owned by L. E. Myers Construction Co.*

PARTIAL LIST OF EQUIPMENT: Ingersoll Rand Portable Compressors, Caterpillar Tractors with Hoists and Bulldozers, Trucks, Bay City Trench Hoe, Hoists—Electric, Mixers, Barber Greene Trencher, 100 ft. Steel Derrick, Pumps, etc., etc.

MISCELLANEOUS SMALL TOOLS and EQUIPMENT PARTICULARLY SUITED FOR POWER and TRANSMISSION LINES.

Send for circular giving full particulars **SAMUEL JACKSON,** Auctioneer, 396 Broadway, New York, N. Y.

Large Surplus Plant
Send for list or call on us for anything in heavy construction.
MASON & HANGER COMPANY, INC.
Engineers-Contractors
500 Fifth Ave., New York

FOR EVERY
BUSINESS WANT
"Think Searchlight *First"*

EARN $2 AN HOUR DURING SPARE TIME

We need a man in every community, full or part time, as our local representative. By recommending and calling to the attention of business men, professional men, or workers, our business and technical books, which will help increase their business or their earnings materially, you can increase your own income each week substantially. All who see our lists, whether in shop or office find not one but many books they are eager to own. They find the ready reference knowledge that gives them quick and valuable assistance in their daily work. You can make $10 to $15 each week EXTRA, showing our lists to your associates or acquaintances during spare time. No experience required. Complete equipment, Free.

Write Tom Crawford, Dept. C.M.

McGRAW-HILL BOOK CO., 330 West 42d Street, New York City

We like 'em

"HARD BOILED"

. . . if they ask us to *prove* that TRU-LAY Preformed Wire Rope will save them money. We welcome such an inquiry from a man who knows what he wants . . . and wants to be shown. That's the way our best customers have been hatched, because shrewd and careful buyers are alive to possible savings in wire rope.

We expect you to be "hard-boiled" in the matter. Because we know if you convince yourself that TRU-LAY gives much better and longer service, we will add another customer to our long list of TRU-LAY users.

NON-PREFORMED

PREFORMED

"I-T" (internal tension) in wire rope is eliminated by preforming strands and wires to their exact helical shapes . . . so they lie in place *relaxed*. As a result, TRU-LAY Preformed Wire Rope gives much longer service and greater efficiency.

TRU-LAY combats fatigue, is easier and safer to handle, resists kinking and high-stranding. Each strand carries an equal load.

The sum of these and other advantages results in worth while wire rope savings.

Tell us your wire rope usage and service. Our experience over a long period of years, in hundreds of instances and applications will prove in good stead . . . to lower *your* wire rope costs, just as we have lowered wire rope costs for others.

Try TRU-LAY Preformed Wire Rope. An ounce of experience is worth a ton of advice.

Address the AMERICAN CABLE COMPANY, *Inc.*
WILKES-BARRE, PENNSYLVANIA

An Associate Company of the American Chain Company, *Inc.*
District Offices: Atlanta, Chicago, Detroit, Denver, Houston, New York, Philadelphia, Pittsburgh, San Francisco

UNKNOWN
on this street for 21 years

Mason Street, Springfield, Mass.

MASON STREET, Springfield, Mass., was paved with TEXACO Asphalt Macadam in 1912. To date, the pavement has never been repaired in any way.

This pavement has the distinction of being the first yardage of Asphalt Penetration Macadam to be constructed by the City of Springfield. Hand-pouring of the asphalt was the vogue in 1912 in penetration macadam work. Two and a half gallons of TEXACO Asphalt were poured in two applications, as initial treatment of two gallons and a seal coat of one-half gallon.

Records of this character expain why almost every leading city in Massachusetts today has a substantial yardage of TEXACO Asphalt Paving.

TEXACO

asphalt

THE TEXAS COMPANY

Asphalt Sales Department

135 East 42nd Street, New York City

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Philadelphia
Boston
Jacksonville
Chicago

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Kansas City
Houston
Dallas
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